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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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NOTES AND COMMENTS.

Internally Chilled Castings.

There appeared in a recent issue of "Stahl und Eisen" a long article on the subject of "Substitutes," by Herr Würth, and when dealing with the question of cast iron towards the end of the war, points out that castings were of poor quality owing to the low quality of coke and the scarcity of pig-iron. The coke was extremely sulphurous and the ash content more than ordinarily high. The lack of pig-iron rendered necessary the use of as much as 80 per cent. of scrap and this often of inferior quality. These conditions brought about a large increase of both foundry and machine-shop wasters, the castings often being so hard as to render machining difficult. These conditions were undoubtedly aggravated by poor tools. Contraction cracks and all the other well-known defects were largely increased. Amongst all these faults there appeared the curious phenomenon of castings being grey on the skin and internally white. Analysis of the two different regions revealed almost exactly the same total carbon content. Up to now no satisfactory explanation of this phenomenon has been submitted. Artificially, they can occasionally be reproduced by quenching a Keep's wedge test in water, when the conditions are such that the centre of the casting is still liquid, and the outside has already precipitated the carbon as graphite. It is, however, difficult to imagine conditions which could possibly obtain in a sand-cast mould which could in the slightest degree resemble the artificial conditions outlined above.

Shock Testing.

Generally speaking shock testing has not been widely adopted for cast metals, probably on account of the fact that much of this material has only to withstand static stresses. Even though castings give poor results in this direction, much more work would probably be available if one particular type of test was universal, or at least the results given by the various machines could be quickly correlated. This question has been studied in France by La Commission Permanente de Standardisation, and useful comparisons with the Charpy and Mesnager are outlined in articles contributed to "Revue de Metallurgie" by Guillet and Legrand. It will be remembered that the Mesnager test-piece is 10 × 10 × 55 mm., provided with a 2 × 2 mm. notch with a curved base, whereas the Charpy test piece, though usually of the same overall dimensions, is distinguished by a round hole of 1.3 mm. diameter drilled tangentially to the large axis, and opened out at the outside with a 1 mm. saw cut. The test-piece adopted by the Commission Permanente has the same general dimensions, but the notch is 2 mm. wide and 5 mm. deep, the base of the notch having a radius of 1 mm. The Charpy test-piece, in comparison with the new standard, gives low results for non-fragile metals, and the scale established for resilience is not sufficiently large. The Mesnager test-piece, on the other hand, does not break when the metal shows a high resistance, and a figure cannot be given. A comparison between the three types shows that although the test-pieces are of the same general dimensions, the official test has a notch of the same width and a similar base to the Mesnager form; but it is provided with a depth comparable with the Charpy test-piece. Thus the fractured area on which the resilience is to be calculated is 8 × 10 mm. with the Mesnager, and 5 × 10 mm. with the Charpy and the official test-piece. On the whole satisfactory results have been obtained from the official test-piece, and there is reason to believe that the test will be generally adopted in France. The standardisation of dynamic testing can only result in the familiarising of interested persons with figures which would immediately convey something to their mind and would lead to the more general adoption of an extremely useful test.

The British Cast Iron Research Association.

Every foundry in the country, to the number of nearly 3,000, has now received a copy of the brochure issued by the Council giving the details of the work to be carried out by the Association and the response already given by the industry is most gratifying. Applications for membership have been received from foundries, pig-iron makers, etc., in all parts of the country, despite the present trade depression. Already several problems for investigation have been sent in, and, the Bureau of Information having now been commenced, the staff are prepared to deal with any technical inquiries.

The support already given by the industry is a good sign that it intends to prepare for the trade revival whenever it arrives.

XUM

A New Type of Core Drying Stove.

A new method of drying cores and moulds, a description of which should be of interest to all interested in foundry work, has recently been developed by Messrs. James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.4.

The plant has been designed to supersede coke firing, and town or producer gas is the usual heating medium, although oil can be used, if necessary. The equipment for each drying stove is complete in itself, except in so far as one high-pressure blower, with the requisite air pipe connections, may be used to serve a number of stoves. Apart from this blower and its connections, each stove is provided with gas injector, burner head, automatic mixture control governor, combustion chamber, and the requisite arrangements for discharge and re-circulation of the products of combustion.

Fig. 1 clearly shows the design of the plant as applied to a single stove. The blower delivers the requisite quantity of fresh air to the injector at a pressure suitable for inducing the requisite quantity of gas which, before it reaches the injector, passes through the automatic mixture control governor. By means of this device, the air and the gas are automatically supplied in the correct proportions for combustion, irrespective of variations that may take place, either in the air pressure, gas pressure, or both.

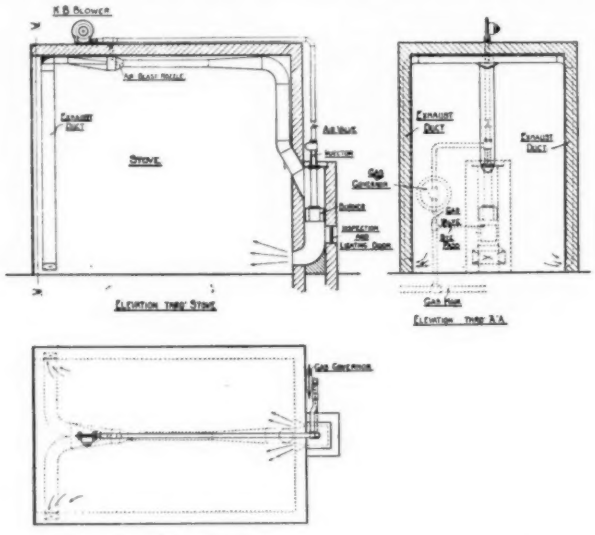

FIG. 1.—A NEW TYPE OF KEITH-BLACKMAN CORE DRYING STOVE.

After mixing in the injector, the combustion takes place at the burner head, which is a cup-like casting with external fins or ribs, the whole being surrounded by a combustion chamber which may be of asbestos-lined sheet steel or of brick-work. After combustion, the hot gases are delivered to the stove at the back (or at one side where the stove has doors at each end), passing across the cores and moulds before reaching the exhaust uptakes. In the illustration (Fig. 1)

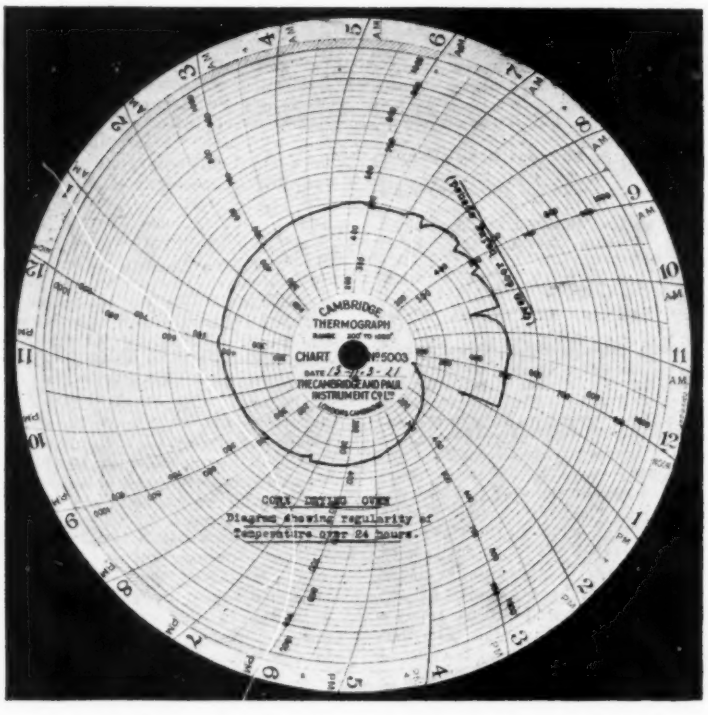

FIG. 2.—A TIME-TEMIERATURE CHART TAKEN DURING A 24-HOURS' RUN WITH THE STOVE SHOWN IN FIG. 1.

these are shown at the front of the stove, one at either side, and where full width doors are used the ducts are let into the side walls. The exhaust ducts rise to ceiling level, and then join together at the throat of the re-circulating injector, which, in turn, communicates with the combustion chamber, so that the products can be re-circulated. The products so returned do not interfere with the combustion of the newly-admitted air and gas as they pass along the annular space between the burner head and the walls of the combustion chamber, but an intimate mixture with the newly-burnt gas is formed on the far side of the burner head, just before the products are again discharged into the stove. Practically the whole of the products of combustion are re-circulated, although a small percentage must be allowed to pass away to compensate for the fresh air and gas delivered to the combustion chamber. Convenient openings near to floor level, or other suitable arrangements for passing away the surplus products, can be made.

Access to the burner head is obtained through a large mica-covered inspection and lighting door, the position of which is shown in the illustration, and a small by-pass with cock is provided, whereby a small jet can be kept lighted, just below the burner head, when the plant is not working.

Ordinarily a stove temperature of 230 deg. C. (450 deg. F.) to 260 deg. C. (500 deg. F.) is maintained, and the temperature chart, which is reproduced in Fig. 2, shows the maintenance of a steady temperature during a twenty-four hours' run on a very successful plant already at work. Temperatures considerably higher than 260 deg. C. can be attained if required, and, as the temperature is under perfect control, it is an easy matter to start up at a lower temperature, and warm up to the desired maximum at the required rate.

Some of the advantages claimed by the manufacturers of this system of drying are as follows :—(1) Rapid warming up of the stove to the required heat. (2) Easy regulation of the heat. (3) Rapidity and thoroughness of the drying, due to the circulation of the products of combustion, the minimum only being allowed to escape. (4) Ability to put the plant in or out of action at a moment's notice. (5) No cartage and storage of fuel. (6) No cartage of refuse. (7) Minimum labour charges.

Obviously the most important factor is the production of clean cores and moulds, which, in turn, result in the output of cleaner castings and the saving of time and labour in the fettling shop.

Core Binders.*

Much ornamental work has been cast in dry sand moulds which contained a relatively small amount of organic matter, but this was of such a nature that it would allow the sand to crush as the castings shrunk on it. We have records several hundred years old describing the casting of bells, columns and other hollow or semi-hollow pieces in which we find the use of hay rope over an arbour or mandril which was covered with loam. In fact, all of the older works treat of the making of the larger cores in this manner.

Just when the other core binders came into use is questionable, but we know that flour has been in use for more than a hundred years, and there is evidence that resin has been used at least as far back. Evidently the poorer grades of flour or middlings were first used in loam or semi-loam mixtures, mainly with the idea of opening up the core or furnishing organic matter to burn out and crush. Sawdust was used in the same way. Flour had been used for a paste for pasting cores apparently before it was used as a core binder itself.

Some time during the last century the use of oil sand cores began, which made possible more intricate castings, such as radiator cores, etc. Many moulders now working can remember when all of the hot water boilers, engine ports for Corliss engines, and other complicated openings in iron or steel were cast with flour or loam cores and a very large amount of rodding was necessary. The steam radiators of thirty or forty years ago were practically all made up of pipe and fittings, and it was not until the oil sand core came into use that it was practical to make cast-iron radiators. Oil sand cores seem to have appeared in a number of nations at about the same time, and certain ones have developed core binders which they use more than others do. For instance, the British foundryman uses what he calls core gum, which is really dextrine, and he prefers this to many of the binders used in this country. Some dextrine is used in the United States, but other binders are used more extensively here than abroad. The Germans developed a binder known as Quelline, which is a modified potato starch and makes a really wonderful core binder.

It was not until quantity production made its demands upon the foundry that core binders were developed and brought out in what we might call classes, Roughly, core binders can be divided into water soluble binders, oil binders and pitch or wax binders.

Under water soluble binders then are molasses, distillery slop, flour, starch, dextrine, the various by-products of the sulphite paper industry, and, in fact, any binder that is rendered sticky by the addition of water and can then be hardened down to a paste by the evaporation of water.

The oil binders proper comprise what are known as the paint oils, of which linseed oil is the best known representative. These oils all have an affinity for oxygen and dry down to a paint film by an oxidising process, and the value of any given oil as a binder is directly in proportion to its value as a paint vehicle. There are certain oils used in making binders which are nothing but vehicles for diluting the binder or for spreading it in the sand, as for instance some of the neutral oils, kerosene, etc.

In the true pitch and resin class then is resin obtained from the tapping of pine trees or the treatment of pine stumps, etc., various synthetic and by-product resins and pitch gums and asphaltums. All of these binders bind by simply melting and flowing to the contact points between the sand. The value of a binder of this class lies to a large extent in whether or not a core made with it can be cleaned from the casting. Ordinary pine resin heads the list in this class from a cleaning standpoint, on account of the fact that there is a definite point somewhat above 300 deg. C. at which resin breaks down into a pitch and an oil, and over 80 per cent. of the material goes off through the vent as an oil, which at that temperature is a gas, and is distilled out. This causes the core to release itself very readily. The other feature of resin is its low melting point for use in such metals as aluminium, magnesium, etc., where the number of heat units per cubic inch of metal is relatively small compared with that evolved from the chilling of a cubic inch of steel, and hence we must have a binder which must soften and allow the core to be crushed.

There is another way of considering the usability of a binder for a given purpose, and that is whether or not it sticks to the box in such a way as to delay the work of core-making. Certain binders make very good cores, but when they are used the coremaker has to be continually cleaning the box, and hence it may be cheaper to use a more expensive binder as far as the binder itself is concerned and increase the coremaker's output.

Another important feature is how sensitive a given binder is to heat. There are certain binders, as, for instance, dextrine and flour, that cannot stand an overheating without being badly burned or broken down, while some of the oils can stand a good deal of abuse in this way. With properly designed ovens, however, this factor is not so important.

In determining the cost of a core we have to take into consideration the cost of the sand, the binder, the coremaker's labour, the cost of maintaining the coreboxes and the cost of cleaning the core from the casting. All of these factors are of great importance in the production of cored castings, and in many cases the most expensive binder pays on account of the fact that it reduces the labour of coremaking on one hand, and the cleaning of the core out of the casting on the other.

* Extracted from "The Foundry World."

Compressed Air in the Foundry.*

By Robert G. Skerrett.

In up-to-date foundries hand ramming is disappearing, for better and quicker results can be obtained by recourse to pneumatic rammers. Compressed air is preferably the impulse medium because it lends itself readily to many added services in the foundry, and it has not the drawbacks which characterise steam or electricity in this environment.

Pneumatic sand rammers of various sizes are provided, and these are principally designed to meet two conditions of packing moulds, either on a bench, where a short tool answers, or for ramming moulds on the foundry floor, for which a longer outfit is desirable. Without going into Sthe structural details of these labour-saving apparatus, it suffices to say that the operator has only to press a conveniently placed throttle lever to make the tool function while he guides it.

The bench rammer is a moderate-sized affair, weighing from eleven to thirteen pounds, and is intended for work on small flasks such as are ordinarily handled on the bench. It is capable of delivering 750 blows per minute. On large moulds, however, which are so constructed that the floor rammer cannot reach all sections effectively, the bench rammer comes to the rescue and is frequently used to advantage.

The floor rammer weighs 22 lbs., and when operated by air at a pressure of 80 lbs., delivers 600 blows a minute. For general tamping the rammer carries a cone-shaped butt, and for getting into corners and close to the contours of the pattern a substitute fan-shaped attachment is provided. On an average, a mould can be rammed by a pneumatic tool in one-fifth the time required to do that work by hand.

But the gain is something more than that of saving time and making it possible for the foundry operative to get through his day's task with less exhaustion while showing a larger measure of accomplishment. No small part of this success is due to the weight and way the equipment is built, for these two factors can be so co-ordinated as to induce a minimum of jar or reaction when running and yet give sharp and strong blows. In short, the workman is not needlessly fatigued by vibration. Air-driven tools of this sort make it feasible to ram the flasks harder and more uniformly than by the older hand method.

Therefore, the walls and mass of sand supporting the pouring cavities are firmer and better able to resist any eroding forces set up by the metal as it flows into these recesses. By reason of this state of the mould the metal is not wasted in the formation of fins, etc., that have to be removed afterwards, nor does it contribute to the production of objectionable overweight castings. In other words, the products are far more likely to be true to pattern and unvarying in weight and quality.

The ramming of moulds, especially for small castings and where identical multiples of these are made in large numbers, is often done by means of jolt ramming and jarring machines. In these, the vibratory motion, by which the sand is packed about the patterns, is imparted by a suitable mechanism operated by compressed air.

Again, there are power squeezing moulding machines, and these, under the impulse of compressed air, bring the mould flasks together, and firmly tamp or force the sand to the proper density about the patterns. Where machines of this sort are used the patterns are frequently made of aluminum, because of its lightness. Further, through a vibratory movement induced pneumatically, after the moulds have been rammed, the patterns are shaken free so that they can be lifted or withdrawn without marring the impressions in the sand. These machines are numerous in design, and the purpose of all of them is to reduce labour to a minimum while promoting the rapid pouring of many castings during a single working shift. Compressed air is peculiarly fitted to play the part of energising medium because the air has a distinctive cushioning effect and yet is positive and vigorous in its action.

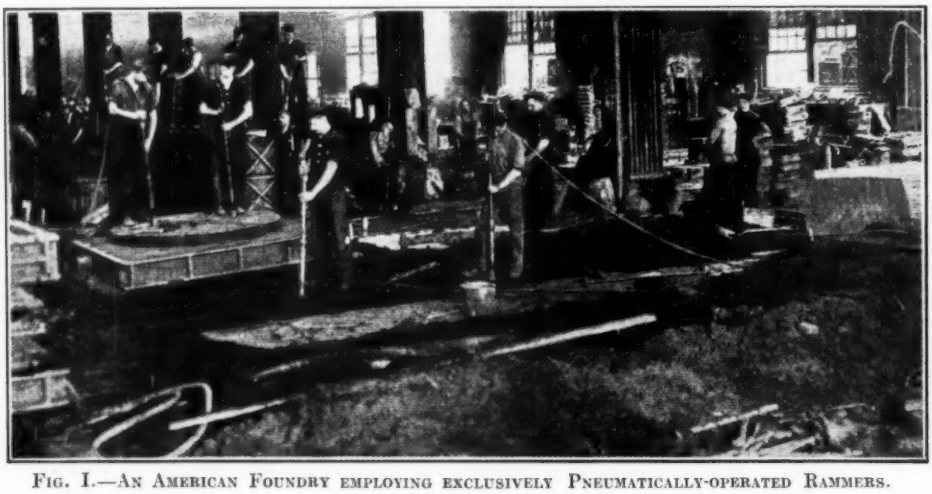

FIG. I.—AN AMERICAN FOUNDRY EMPLOYING EXCLUSIVELY PNEUMATICALLY-OPERATED RAMMERS.

Jarring apparatus, ingenious as they are, have their limitations, and the work done by them is not always complete enough to obviate finishing touches with the man-guided pneumatic rammer. According to one eminent foundryman: "For medium-size work that is made in quantities, we believe the jolt machine to be indispensable; even with this, however, the sand rammer is a very important factor in butting off the tops of the jolt-rammed moulds. When larger patterns are rammed it has been our experience that the sand rammer is equal, if not superior, to the jolt machine. This statement is made after taking into account the expense and labour incident to rigging up a pattern for use on a jolt machine, the tendency the mould has to sag upon being rolled over, the bolting on of the plates before rolling the drag, and such other details as are encountered in rolling over a large job. On the other hand, if the pattern is bedded in the ground or flask and rammed up with pneumatic rammers, which may be done with unskilled help, much of the expense and delay is eliminated, while we are sure of a perfectly true job conforming to every detail of the pattern. And it may be said positively that pneumatic rammers can be used on both copes and drags indiscriminately and with equal success."

Compressed air in the foundry does not end its

* Extracted from a recent issue of the "Compressed Air Magazine."

service with the functioning of sand rammers and the operating of jarring and moulding machines. The worker, in finishing his mould prior to the teeming of the molten metal, finds this handy source of energy of material aid to him. Anyone acquainted with the procedure in many small and even large conservative foundries is familiar with the hand bellows ordinarily employed by the artisan for blowing off mould surfaces and getting loose sand, etc., out of corners and other more or less troublesome recesses.

To-day, he is able to do this better and quicker by recourse to an "air gun" that supplies a steady stream, which he can regulate to a nicety to suit his needs. In making up his mould, the moulder must have within reach plenty of sand; in fact, he usually requires several kinds according to the nature of his task and for different parts of the mould.

Pneumatically-actuated sifters have been developed of divers types, and some are portable while others are intended to do their work at a permanent position in the foundry. The portable apparatus saves the time and expense of wheeling sand to and from the screen in supplying the moulder—the sifter can be set up anywhere, generally close to the mould. It has been authoritatively said, speaking of the economies made possible by these sifters: "Including the cost of air, based on an efficient compressor installation, and allowing the current rate for labour, it is entirely practicable to effect a substantial saving in view of the fact that one man with one machine will screen in a single hour as much sand as a man would ordinarily riddle by hand during a working day."

Amongst the several aims of the moulder is that of facilitating the peeling of the casting from the sand. As may be readily understood, the intensely hot, fluid metal would naturally be expected to fuse some of the sand forming the mould walls and thus to cement it to the solidifying iron, steel, brass, etc.; and knowing that this admixture of sand and metal must be removed to make the casting acceptable, the moulder resorts to an expedient to reduce or to prevent this undesirable action.

That is to say, he coats the surfaces of his mould and cores with a film of blacking, and this tends, when the blackening is done well, to hold the sand and the metal apart. According to the size and complexity of the mould and its associate core or cores, skill and possibly a good deal of time are required to do this work properly. Once more compressed air does its bit; and a simple and rugged type of atomiser has been devised which meets the demands of this service.

Up to now, nothing has been said about labour saving through mechanical lifting; and yet it should be self evident that the flasks, the prepared moulds, and the ladles charged with liquid metal have to be shifted from point to point during the preparatory stages and the actual teeming of the metal. For these various functions the air hoist is especially suited. Similarly, when the moulder has finished with his patterns, and when the castings are cold and ready to be moved to another part of the foundry, the pneumatic hoist again comes into play. After the patterns of large castings have been drawn from the "cope" and "drag" it is necessary to set the cope on the drag by a mechanical hoist, and the pneumatic geared hoist is far more satisfactory than any other type of hoist owing to its delicacy of operation, which enables the operator to accomplish this without jarring loose the sand. The pneumatic hoist is so simple in its working that a boy, with its aid, can lift a given load a dozen times while a gang of several men, using a chain block or windlass, would be raising the same weight once.

In the actual melting of the metal in the furnace or cupola, and in preparing the ladles to receive the molten metal for pouring, compressed air has useful functions to perform. Compressed air may be used to atomise the oil when liquid fuel is employed in the furnace or for otherwise stimulating the draft to promote combustion and the generation of necessary heat. And the air torch similarly serves to raise the temperature of the ladles so that they will not chill their charge when the metal is teemed into them prior to pouring the moulds. In passing, it should be said that the air-operated oil torch is doing good work in many foundries in skin drying and baking moulds and cores and likewise in salvaging condemned castings.

In large and somewhat complicated castings the first thing demanding attention, after the newly formed metallic mass has been lifted free of the sand, is that of getting rid of the cores which, primarily somewhat firm, have been baked and further hardened by the contiguous molten iron, steel, brass, etc. Clearing away cores by hand is a toilsome and expensive procedure, and to save time and work pneumatic core breakers have been devised. These tools are extremely effective and efficient, and do much to reduce foundry costs.

To accomplish breaking or cutting off the "sprues" and the "gates," air-driven hammers, chippers, and grinders have been evolved. But there is another agency that is largely relied upon to clean the surfaces of castings, *i.e.*, the sand blast. The term sand blast is self explanatory, and consists in exposing a casting or castings to an artificial sand storm impelled by compressed air.

Formerly, sand blasting was decidedly unhealthy work, but the operator is now safeguarded from the harmful dust by a suitable respiratory equipment in the form of a helmet, etc. It is practicable to regulate the air pressure and, therefore, the impinging force of the abrasive agreeably to the character and the material of the individual casting. A few examples will show the economies made possible by the sand blast. By the old hand method a coupling would require two and one-half hours to clean, while the sand blast can do it in less than five minutes. Gas engine cylinders are cleaned in 30 minutes by air blast as against four hours by the tedious manual procedure.

Sand blasting has been brought to a high stage of development, and an up-to-date installation for the speedy handling of large and numerous castings is made up of a sand-blasting machine, a sand-separating machine, a sand elevator, an exhauster, and a dust arrester. As authoritatively described: "The sand-blast machine is placed in a separate compartment from the sand-blast room and is arranged to operate through the dividing wall quite as well as if it were directly in the blast room.

By this arrangement the sand-blast compartment is devoid of hampering appointments or apparatus, giving that much more working space, while the sand-blast machine is not exposed to the injurious or wearing action of sand and dust. The sand, after being blown upon the castings, falls through a grated flooring into a hopper, whence it is carried to the elevator boot, and the latter transports it to the sand-separating machine, where pieces of material, larger or smaller than desirable, are sifted out and deposited into a bin. The clear sand for re-use is dropped into another bin directly over the sand-blasting machine.

"The dust-laden air is taken from the blast room through suction pipes located beneath the grating. In going through the dust arrester, the dust is thoroughly separated from the air and falls into convenient hoppers. The clean air is then passed back into the room through spaces in the ceiling. This system insures proper ventilation." It seems, where comparisons are made between cleaning by pickling and cleaning by sand blast, that a very handsome saving both in labour and time can be effected by the pneumatic equipment. By adding a sand blast, which discharges into the barrel through the centre of one of the supporting bearings, the castings can be cleaned quicker and better than where dependence is placed entirely upon the rotating action of the container.

It is not possible to present as a whole the economic benefits resulting from the employment of compressed air in the foundry, but inasmuch as pneumatic appliances have been instrumental in reducing labour costs by as much as 50 per cent. in some directions; have cut down the time of manufacturing processes tremendously; have made it feasible to obtain the while superior castings and products; and have very measurably lessened the quantity of defective commodities, the broad benefits can be grasped

XUM

Stainless Steel.*

By Elwood Haynes.

With the discovery and manipulation of high-chrome steels, an alloy has been revealed and manufactured which resists corrosion to a most remarkable degree, and which is now termed "stainless steel." Such a steel must contain iron, chromium and carbon, and may contain various other elements, such as manganese, molybdenum, tungsten, silicon, etc. Moreover, such a steel does not become distinctly immune to atmospheric influences until the chromium reaches at least 8 per cent., and only exhibits its highest quality when the alloy contains 11 or 12 per cent. Most of the combinations thus far in use contain from 12 to 20 per cent. chromium as an essential constituent. An alloy of chromium with iron and carbon, containing as high as 60 per cent. chromium, may be worked to some degree under the hammer if extreme care is used in its manipulation.

If steels of this character be freed from adhering scale or rust, they will resist atmospheric influences to a most marked degree, far excelling in this respect such metals as tin, nickel, lead, cobalt, copper, silver, etc., and such alloys as brass, German silver, Monel metal, etc.

For most purposes the carbon content of these steels should lie between 0.4 per cent. and 0.8 per cent., while steels of considerably higher carbon may be utilised with advantage for special purposes.

The manufacture of these steels is comparatively simple, though the best results are obtained by means of the crucible or electric furnace. Those made by melting the steel in lined graphite crucibles, when proper precautions are taken, may be teemed into ingot moulds, and show even less oxidation during pouring than the ordinary carbon steels. If the ingots thus produced are of small size, and hence readily chilled, they are usually quite hard when taken from the mould and require annealing before they can be worked on the lathe.

If small flat bars are heated to about 815 deg. to 980 deg C. and allowed to cool in the air, they will become hardened to a very considerable degree, and for many purposes no further hardening will be necessary. If, on the other hand, extreme hardness is desired, the article may be quenched in oil or water.

After the ingot is removed from the mould it is placed in a clear fire (in which coke, oil, or gas may be used as fuel), and brought to a temperature of from 815 deg. to 980 deg. C.; it may then be readily forged or rolled into bars. When properly heat-treated it becomes highly elastic, and may be given almost any desired hardness by drawing at the proper heat. It shows practically no scale during the hammering process, and this fact largely compensates for the increased hardness of the hot metal over that of ordinary carbon steel. It may also be drop-forged under suitable dies, though it, of course, offers greater resistance, and hence greater wear and tear on the dies.

Chemical Properties.—As already stated, the chromium content of a stainless steel should be at least 12 per cent., and may rise as high as 25 per cent. without seriously interfering with the workability of the steel, providing proper care is exercised. All things considered, a very good stainless steel may be made containing, say, 15 to 18 per cent. chromium, with carbon ranging up as high as 0.8 per cent.

When such a steel is rolled or hammered into a bar and afterwards heat-treated and polished, it shows remarkable resistance to atmospheric influences, salt water, nitric acid, sal ammoniac, vinegar or mixtures of salt and vinegar, as well as to the action of citric acid. If the chromium be raised to 40 per cent. or over and a small amount of molybdenum added, the steel will resist boiling solutions of salt and citric acid, even in the concentrated form.

Influence of Temperature.—When a polished strip is heated in a Bunsen flame, it first takes on a pale straw colour, then pale brown, gradually passing into a bright blue, and finally culminating in a deep blue-black. Samples containing a suitable quantity of chromium may be held at a temperature of 800 deg. to 1,000 deg. C. for an indefinite time without showing any tendency to scale. The steel is much more rigid under high temperature than the ordinary carbon steels, and articles exposed to high temperatures would hence retain their shape much better under stress.

Physical Properties.—As already stated, the steel may be forged at temperatures varying from 800 deg. to 1,200 deg. C., and may be readily rolled into rods and sheets under proper conditions. By proper annealing, a bar of 15 per cent. chrome steel can be rendered sufficiently soft to be worked in the lathe, though even when annealed it is much harder than ordinary machinery steel.

When thin strips are heated and allowed to cool in the air, they become almost file hard; and even ingots cast in thin flats in a graphite or steel mould are almost file hard, even when allowed to cool in the air.

The steel yields to heat treatment quite readily, though its recalescence points are generally higher, and the steel does not respond so quickly to treatment as do the ordinary carbon steels. Complete data under various heat treatments are lacking, but the following may be taken as fairly representative:—elastic limit, 51 tons; tensile strength, 89 tons; elongation, 2½ per cent.; scleroscope hardness, 80.

It will be noted that the elongation of the heat-treated steel of this character is rather low, but, on the other hand, it is distinctly perceptible. It will be further noted that the ultimate breaking stress is considerably above the elastic limit, which indicates also that the steel is much tougher than a carbon steel of the same hardness.

Uses of Stainless Steel.—The peculiar properties of stainless steel suggest its use for a great variety of purposes, such as pans, kettles, knives, forks, hatchets, axes, saws, chisels. The alloy will also doubtless find larger use in the form of pump shafts, driving shafts, ships' propellers, etc. Its high modulus of elasticity and high tensile strength as compared with bronze especially recommend it for these latter uses. Its resistance to comparatively high temperatures, together with its tendency to retain its form, will doubtless render it of great service in the form of retorts for various operations, such as gas making, shale distillation, and various other uses.

Owing to the comparatively high percentage of chromium, the cost of the steel will always be more than that of carbon steels.

* From a Paper read before the American Iron and Steel Institute The author is President of the Haynes Stellite Company. Kokono, Ind., U.S.A.

Iron Castings in the Electric Furnace.

Under normal conditions, and when dealing with common castings, melting the iron in an electric furnace is not a commercial proposition. For a considerable time, however, the demand for castings was much in excess of the supply, and, as a consequence, prices ruled abnormally high. It was this position on the one hand, and the restricted demand for steels on the other, which led the Stobie Steel Company, Dunston-on-Tyne, to consider the possibilities of bringing down iron in a 15-ton Stobie electric furnace. In view of the fact that an adequate quantity of scrap was available, the furnace has for some time been engaged upon that duty, and considerable quantities of locomotive and marine castings, ranging in weights up to 10 tons, have been profitably produced.

Where castings of high tensile quality are required for special purposes, it is probable that the electric furnace will have to be considered, as obviously the quality of the iron produced is under absolute control; neither is that quality dependent to any extent upon the analysis of the bulk of the charge, as the required additions can be used to build it up. Then, too, there is the all-important point of sound castings, and the percentage of such would be appreciably higher with the electric furnace as the absence of gas in the metal practically eliminates blowholes in the castings.

The Design and Equipment of an Iron Foundry.—Part I.

By Joseph Horner.

This article proposes to deal with a typical foundry which is representative of by far the largest number of shops in this country—one that is neither very highly specialised in its products, on the one hand, nor neglectful of labour-saving methods, so far as they are suitable to the work done, on the other. It is assumed, too, that the foundry is of fair average dimensions, giving employment to, say, 80 to 100 hands all told—moulders, coremakers, labourers, etc. In a shop of this general character there will be light, medium, and heavy castings, made in green and dry sands and loam, the relative proportions of which will depend on the nature of the firm's product. In a marine or a heavy pump shop, loam will occupy a large place; in a machine-tool maker's, none at all; in a crane shop, a considerable volume. In all foundries green sand occupies the most important place. Here the question of machine moulding, with the many-sided issues which it involves, arises, as the plating of patterns, the selection of machines, the division of tasks, and so on. Broadly, these matters are decided on the basis of the volume of repetition work done. Since also independence of outside help is desirable in the case of rush orders, it is very convenient to include a small department devoted to brass work, or this may supply all the brass and bronze castings required. Since the layout and equipment of the shop is determined by these decisions, it is well in the first place to consider the foundry building.

The Shop Building.—Only one design can be regarded with favour at the present time—the parallel bay, with unobstructed roof light. The building may be square or oblong, according to the site available, but it is usual to divide the area into two or more bays (Figs. 1 and 2), apportioned to the different classes of work done. It is not desirable to have separating walls between the bays. The whole area should be unobstructed, save for the columns that support the roofs, affording freedom of movement between the bays and observation of the whole to the foreman. A low wall is useful in some localities for hanging up articles, such as plated patterns, sieves, bellows, etc., and for heaping a sand supply against. In the illustrations the outer walls are of brick, but within the foundry area the roofs are supported on columns. In some present-day buildings the outer walls do not support the roof, being merely curtains, of brick or other material, built between the columns that carry the roofs there. Cast-iron columns are suitable, but often those of rolled-steel sections have preference. Offset pieces can be built into these to sustain gantries for the overhead travelling cranes, and they can be utilised for the support of ventilating pipes when these are installed. The main columns of large section generally stop at the crane runways, and are surmounted with lighter members, cast or rolled to receive the roof principals. Columns have broad bases to bed on a concrete foundation, and with a grillage of crossing steel bars in treacherous soils. They are connected above with horizontal joists, which may be of light ties only, or runways for cranes.

Steel alone is used for roof principals (Figs. 2 and 3). Timber was common at one time, blocking light and accumulating dust. The steel principals receive the purlins, of channel, angle, or tee section. These are variously covered, and methods of lighting differ. Slates are better than tiles, secured with copper nails, and it is better if laid on a felt lining, spread on boards about 1 in. thick. A ridge roof with a louvre is the usual form preferred. The slats afford ventilation, and are too high up to cause a sense of draught except in very cold and gusty weather. Illumination is provided by a continuous skylight along each slope, which may occupy one-half the width of each ridge. This will be ample even if no light is admitted through the outer walls, but windows here, with iron or steel sash frames (Fig. 4), have a more cheerful appearance than dead masonry. The objection to this general design is the glare of sunlight in summer time, to avoid which the saw-tooth roof, which admits only north light, is adopted in some instances. The glazing must be done with care if leaks, which play havoc with moulds, are to be avoided. Ordinary glass, even the stout 21-oz., is liable to fracture. Putty is of little use. One of the systems of puttyless glazing should be adopted, and a thick glass like the "Refrax," which is about ¼ in. thick, fluted on the lower face, and if desired encloses wire netting, which in the event of fracture prevents the fragments from falling.

Question of Extensions.—An advantage possessed by a building rectangular in plan is the facility which it affords for future growth. While laid out in the first place to suit the character and volume of the work being regularly done, the requirements of the future cannot always be forecast, and the probability of extension must not be overlooked. In occupying a site, therefore, it is well to leave room for longitudinal growth. This is easily accomplished with the type of building described. It simply means repeating the elements—the columns, roof principals, purlins, and coverings—with the removal of one end wall. If ground does not happen to be available at one end, then a flanking bay is the alternative, also a replica of the one first built. In each case straight, unobstructed shops favour the movements of everything, with economy of time.

Dimensions and Arrangements.—When planning a foundry, its dimensions and the disposition and location of the work to be done depend on the character of the work and its volume. Only when the output of a foundry is strictly standardised is it possible to estimate the moulding areas and the plant and machinery with precision. Then, the exact daily tonnage being known, and the dimensions of the moulds corresponding, everything can be reckoned out on that basis. But this is not the case in probably nine foundries out of ten in England. The character of the castings, their dimensions and weights, vary from week to week, with corresponding differences in tonnage. A lot of small castings go to a ton, a large casting will weigh several tons. Some green-sand moulds of large dimensions will occupy several days in the making and coring, appropriating much floor area. Many loam moulds take a week and more in preparation, also requiring much floor space and large drying stoves. It is therefore for a foundry handling a usual proportion of every class of work, general and special in character, that the plan arrangements in Fig. 1 are designed. It is 180 ft. long by 105 ft. between the outer walls, divided into three bays of equal widths, and having extensions on one side for plant and machines. It has a total area of 18,000 sq. ft. within the main building, and, subject to the varying conditions just enumerated, should be capable of turning out an average of from 15 tons to 20 tons a day.

Relative Floor Area.—This, which is easily determined when work is wholly specialised, can only be estimated roughly, helped by previous experience in a general shop. Some approximation to the floor area required for each department must be made. This has to be estimated chiefly by the room required for the moulding boxes during the preparation of the moulds, when the patterns have been delivered and the flask parts laid open on the floor for cleaning and coring. The day's output in plate and machine moulding will cover a large floor, the sections of loam moulds before their final closing occupy large spaces, and always there must be clear spaces of a foot or more to permit of the men moving about round the mould sections.

Green-Sand Moulding.—In all shops this immensely predominates. The first division made is that between light and heavy castings, allotted to adjacent bays or to separate areas in one bay. This separation is necessary because the hoisting and transporting tackle and other services

must correspond with loads. Overhead travelling cranes and swing cranes are required for heavy moulding boxes, while for light work these are not necessary, but overhead tracks and trolleys are more suitable; while for work done on the floor, in charge of hands selected for that work. As specialities increase, these subdivisions should keep pace with them, as, for example, cylinders of a certain class, pulleys, gear wheels, railway chairs, etc., which articles, with many

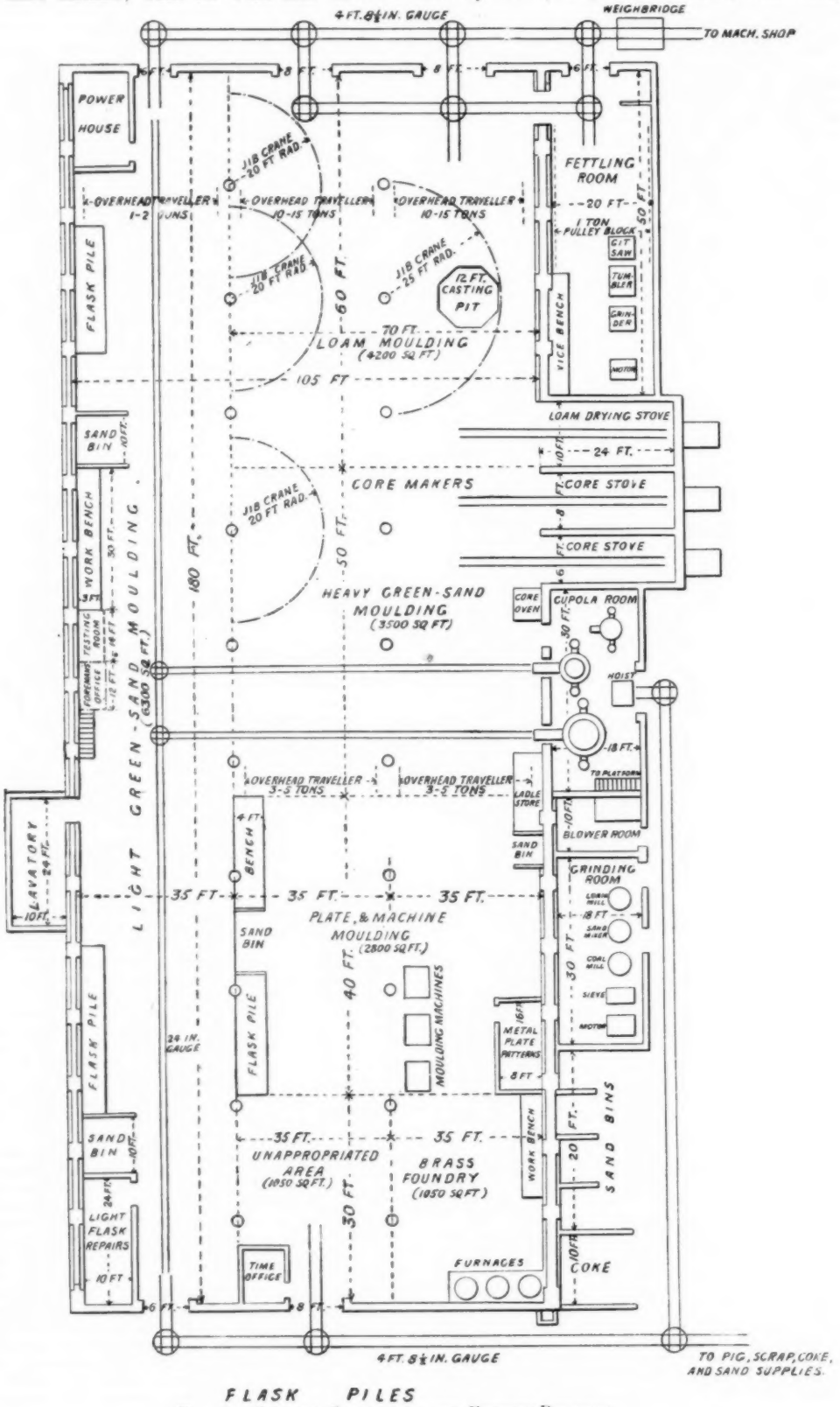

FIG. 1.—GENERAL LAY-OUT OF THE FOUNDRY BUILDING.

bench, and on small moulding machines, only manual carrying is required. More than this is desirable in the way of specialisation whenever possible. If a fairly large output on one article or a group of allied forms exists, or is anticipated, this should be assigned to a separate area

others, lend themselves admirably to plate and machine moulding. In the plan arrangement (Fig. 1) it will be seen that a large area in two adjacent bays, with 3,500 sq. ft., is given up to heavy green-sand work, and the whole of one bay adjacent to the lighter tasks, with an area of

6,300 sq. ft. In addition, there is a section devoted to plate and machine moulding, all done in green sand, with an area of 2,800 sq. ft. Thus a very large proportion is given up to green sand, and the long bay, with 6,300 sq. ft. of area, for light castings, provides room for general work or for the separation of specialities into distinct areas.

Core-Making.—In any shop core-making bears a considerable proportion to the volume of moulding, and a separate area is required, with drying stoves adjacent. The making of heavy cores includes that rammed in boxes, and swept on bars, or with strickles. A small area is set apart for the small cores. The coremakers are accommodated in a corner of the heavy green-sand floor.

Loam Work.—This may be large or small in volume, or non-existent, in which case more room will be required for green sand. When present its area is kept distinct, and the work is done by men who seldom handle green sand. It requires a large area because of the separation of the mould sections, and powerful lifting tackle, properly an overhead traveller, often supplemented with a swinging jib crane, since mould sections are often being held up for considerable periods. A drying stove of large dimensions is necessary,

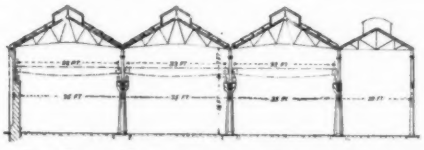

FIG. 2.—CROSS SECTION OF THE FOUNDRY BUILDING.

and a pit (Fig. 1) for lowering deep moulds into for casting. Iron rings, swept roughly in green sand and superimposed are suitable, but a hexagonal or octagonal pit is better, made with plates having flanges similar to those of tank plates, but stouter, say 1 in. or 1¼ in. thick, and cast in one or in two tiers. The loam mould is lowered into the pit and sand is rammed between the mould and the pit walls. An area of 4,200 sq. ft. is allotted to loam.

Brass Foundry.—30 ft. at the lower end of the right-hand bay is given up to a small brass foundry, having an area of 1,050 sq. ft. A similar area in the adjacent middle bay is unappropriated, except for the time office. It can be utilised for stacking a few of the smaller flasks that are in most frequent request, or the floor can be occupied with any unusual output of moulds made in the machine department or the brass shop close by. As the bays are only separated by columns there is complete freedom of movement between them.

Tracks.—Here the question arises of affording ready communication within and between the

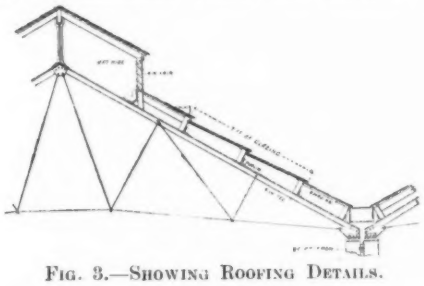

FIG. 3.—SHOWING ROOFING DETAILS.

shops. The arrangement shown is the best. Only in one shop, that for light green-sand work, is a track of narrow gauge provided. It is not desirable to lay tracks in the departments where heavy work and loam is done, since they would often hamper the handling of large mould parts, while the flasks, rings, plates, etc., can be more easily transported with the overhead cranes than on small trucks. It is desirable, of course, to keep a clear central gangway, though not absolutely necessary except at casting time, when all the moulds are closed. The foreman will then see to this. But the entrances to and the exits from the shops are all served with tracks of standard gauge for the supply of materials and tackle and the removal of castings. The first are all brought in at the lower end of the building, the second are despatched from the top end. Opposite each doorway is a turntable. The standard tracks enter the building to a distance of about 6 ft., sufficiently for the overhead cranes to unload and load. All the doors, of sheet iron stiffened with angles, slide vertically in guides, being counterbalanced with weights suspended from chains passing over pulleys to the tops of the doors. A track goes through an open doorway into the fettling room, which has an area of of 1,100 sq. ft., but some of the very heavy castings are cleaned outside the building. The fettling area is sometimes included in the main building at one end—not a good design. Here it occupies a wing outside, with the weighing office at one end, next the weighbridge, over which all castings must pass when despatched to their destination. The room has an ordinary equipment of git-saw, emery grinder, and tumbling barrel, with a vice bench, leaving enough clear floor room for the larger castings lifted, and turned about with 1-ton hand pulley blocks. A sand-blasting room is not included, this being more suitable for foundries with a very large output.

Plant and Machinery.—These are mostly conveniently located on one side of the right-hand bay. The drying stoves, adjacent to the areas occupied by the loam moulders and coremakers, each have a central track on which the core carriages are run in and out. As the temperature ranges from 400 to 500 deg. Fah., it is well to line the interiors with firebrick. Heating may be from coke fires outside, a common method, or with producer gas, which requires a plant, or with oil spray. The loam stove is the largest and tallest, being 10 ft. high, and even then very deep moulds have to be divided for drying. The core stoves are built in two sizes. A small core oven adjacent

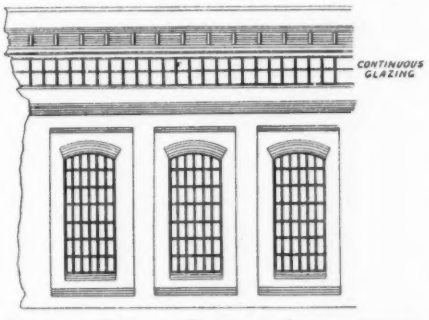

FIG. 4.—WINDOW LIGHTING ARRANGEMENTS.

is convenient for the small round and square cores in regular demand.

The Cupolas.—The cupola room adjoins the core stoves. It occupies a central position for convenience of serving the extreme ends of the foundry. Sometimes the cupolas are located within the foundry walls, but it is better to have them outside with the tapping spouts coming through the foundry wall. Three furnaces are provided, of 6 ft., 3 ft., and 18 in. diam. respectively. The first two are for regular service, the third is for small melts of special metal for making tests, or for a rush order with overtime. The 6 ft. cupola (outside) will melt from 8 to 10 tons per hour, and the 3 ft. size from 2 to 3 tons. Generally only one will be running at one time. Only for a very heavy day's cast will both be required. It is well to have them fitted with receivers to hold the metal until wanted. The smaller cupola should, when possible, be used rather than the larger, because the bed charge of coke is less. In the average shop, the quantity of iron run down per day varies so much that the choice of two cupolas is justified. The foreman goes round in the morning and ascertains the total metal required for the day before lighting up.

A stage is erected at about 2 ft. below the charging doors of the cupolas to carry the pig and scrap required. It is reached by iron stairs (see Fig. 1), and is supplied with metal from a hoist. The platform of the latter in its lowest position is level with the track coming in from the yard. The hoist is served by electricity, or, in many cases, with pneumatic power or steam, or by

hand. The platform must be substantial to carry the heavy loading, and should be able to sustain 500 lb. per square foot. It is constructed of chequered steel plates, carried on steel girders built into the walls. A weighing machine must be installed to deal with the charges of pig, scrap, coke, and limestone. Adjacent to the cupola house is the blower room. Assuming a maximum melt of 9 to 10 tons per hour on heavy casting days, a blower of 30 b.h.p. should be of ample capacity. This would also be suitable for a fan of equal duty.

Next in order is the shed for the preparation of sands. When sand comes from the quarry it is wet and lumpy, entirely unsuited for use in moulds. It has to be dried, ground, disintegrated, sifted, and mixed. Each engages the services of machines. These, in the illustration, are separate units, entirely unrelated. Only in very large foundries are they combined in one large system, where the sand is brought in crude at one end, and delivered ready for use at the other. Only in large plants are machines used for drying. These are long cylinders rotated with their axes set at a few degrees of angle from the horizontal, in which the sand during its passage from the higher to the lower end is subjected to the heat from a furnace. In most foundries of moderate dimensions the new sand is heaped on a plate on the core carriage, and ran into the oven for a night. Often when sand has been stored for some time drying is not necessary, or some moisture is got rid of during the grinding and beating. The old sand, a proportion of which is mixed with new, has lost its moisture, and has to be wetted. Essential machines are indicated on the plan. These are, a grinding mill for loam, one for grinding coal to dust, a sand disintegrator and mixer, a sand sifter, which may be either reciprocating or rotary, with a motor, to drive each machine from a belted shaft. The sand bins adjoin, being in an open-sided shed. The coke shed is the last on this side of the foundry. Large stocks of coke are stored elsewhere as convenient, but that in the shed is renewed as required for the cupolas, and loaded on a truck.

Working back within the other wall of the building, the first department is a small shop devoted to the repairs of light flasks. Accidents happen, corners or stays fracture, pins work loose, lugs break, and it is not worth while sending those jobs to the fitters. A small forge, a vice bench, a drilling machine, a few common tools, and a handy man are all that are necessary. Adjacent is a sand bin for the moulders' use in that part of the bay. Then a pile of small flasks occupies the wall, flasks kept in the shop, because they are in daily request for repetition work. Outside the building is the lavatory. Beyond and within is the foreman's office, reached with a flight of stairs, and, being situated midway along the buildings, it gives him a survey of the entire shop area. Adjoining is the testing room, with a machine for making a transverse and tensile tests of specimen bars. Laboratory work may or may not be included. Down on the floor beyond a department for light moulds may include a bench, a sand bin, and a pile of small flasks. The power house occupies the corner, having a generating set that supplies current to the various motors, including those which drive the cranes.

The Crane Service.—In Fig. 1 overhead travellers and swinging jib cranes are both indicated. The traveller, which covers the whole floor within its span and length of runway, is better than jib cranes which have a limited radius, if the selection of one must exclude the other. But, apart from the expense, the alternative need not arise. The jib cranes, being pivoted on the columns, do not block space. Their utility is great, because, though the radius of action is limited, they serve moulding areas within their range, and so prevent the traveller from being held up, often for considerable periods, to the delay of the tasks of other squads of men.

The cranes selected are of different powers. To serve the bays where heavy green sand and loam moulding are done, overhead travellers of 10 to 15 tons capacity are generally suitable, depending on the weight of the heaviest castings made in a shop. It is better to have ample margin of power than to be handicapped when occasional heavy work has to be tackled To serve the other ends of the bays cranes of from 3 to 5 tons are suitable. The swinging jib cranes are of longer radius and of higher lifting capacity at the upper end of the foundry than at the lower. No crane service is required in the brass shop. The long, light castings area that occupies the whole of the left-hand bay hardly needs a crane service, since the flasks are mostly or wholly of small dimensions, such as can be lifted and turned over by hand, while the central floor track provides for rapid and easy transport. But a light overhead crane is a useful stand-by, of from 1 to 2 tons capacity only. It will run the length of the shop within a minute. A permanent attendant is not required as on the cranes in the heavy bays. It can be worked with a dependent rope from below. The alternative is an overhead trolly track with hoists operated by hand or electricity. These do not cover the whole area, but the traveller does. In the heavy travellers it is well to have two speeds of lift, which economises time when light loads are being handled, which are always in the majority. Continuous current motors, series wound, using current at 220 volts, are the most suitable for crane service, because a large variation in speed with variable loads is obtained. Motors run at from 450 to 500 r.p.m., with a rise of temperature not exceeding 75 deg. Fah. in half-an-hour's working. Each motion, lifting, travelling, and cross traverse, should have its own motor, suitably rated.

Storage of Flasks, Tackle, and Material.—Flasks form the largest single group of the equipment of a foundry. They accumulate rapidly, alarming in view of the metal locked up in them, and the room required for their storage. Very many large flasks are necessary, even though much bedding-in may be done, since plain tops are required, and the boxes of medium and small dimensions run into thousands in a foundry of average capacity. For most of these the storage must be outside. The best location is at one end, or both, flanking one of the main trolley tracks, and covered with a hand-operated overhead travelling crane mounted on a gantry. The small flasks, those of 30 in. and less in diameter or length, which can be lifted by hand, can be stacked as most convenient, some out of doors, others in regular use, within the foundry walls, adjacent to the moulding areas where they are wanted. Only in one group of work can the employment of flasks be avoided, that of the snap flask moulds, which are only suitable for those not larger than about 14 in. square, and of a plain character. The flasks being hinged at one corner are opened out, leaving the rammed or pressed sand mould standing on the machine table, ready for removal to the floor for loading and pouring. Loam plates and rings, core bars and plates occupy much space, and these are kept outside with the large box parts. Articles that are stored within are lifting beams, sling chains, grid patterns, the smaller core grids, wooden joint boards, and other aids, which are either leaned against or hung on the foundry walls.

Large storage areas are desirable for the pig and scrap, because it is well to lay in stocks when prices are low. These are kept in the open, and are loaded on a trolley to be run alongside the cupolas. Much labour may be saved in loading by the use of an electric lifting magnet. The 220 volt current is used. No arrangement of pig or scrap is necessary, but the magnet is lowered on the loose heap, the current turned on, and the lift made. The same magnet can be used for lifting the ball for breaking heavy scrap. A similar magnet suspended from an electric traveller within the foundry will lift castings without the labour of slinging them, even though they are too hot to be touched by the hands. For much of the rougher work of foundry service the magnet economises labour.

Moulding and Casting Equipment.—While the methods adopted in any foundry must be correlated to the character and the volume of the work done, there are fundamental facts which are of general application. They concern primarily the making of moulds, the question of the employment of machinery in the various stages of progress of the work being carried through, and the grading and melting of metal.

(To be continued.)

A Large Malleable Casting.*

The two large and intricate malleable iron castings shown in Fig. 1 formed part of an order of 50 recently completed by the Fanner Manufacturing Company, Cleveland, U.S.A. The casting is 4 ft. in diameter and weighs 538 lbs. The method adopted for producing this casting is shown in Figs. 2 and 3. The thickness of the

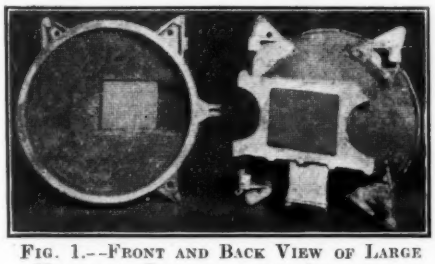

FIG. 1.—FRONT AND BACK VIEW OF LARGE MALLEABLE CASTING BEFORE ANNEALING.

metal is only ¾ in., and for that reason it was not considered advisable to make a pattern the exact duplicate of the casting inside and out. Such a pattern would be too light and flimsy and would inevitably warp out of shape. A metal pattern would have been the logical form to adopt, and probably would have been used if the size or extent of the order warranted. However, for 50 castings the cost of a metal pattern was considered excessive and the method illustrated in Figs. 2 and 3 was adopted. As will be noted in the illustration practically two patterns were constructed, one to form the outside of the mould and the other to form the inside. In addition to these a right and left hand core-box was provided for making the dry sand bracket cores *A*, *A* in Fig. 3, and another for making the dry sand lug cores *B*, *B* in Fig. 2.

The mould was made in a 4-part flask, a drag, two cheeks and a cope. The partings in the mould were made at the points indicated by *C*, *D*, and *E* in Fig. 2.

To bring the assembled flask to a convenient height for pouring with four bull ladles it was decided to dig a hole in the foundry floor and sink the drag flush with the floor. Here it was carefully levelled and the sand shovelled all around it and rammed into place. Setting the drag permanently and definitely in this way for the first casting saved considerable work on each subsequent mould that was made. It will be apparent that by having an approximately level bed to start with each time the operation of setting the pattern would be reduced to a minimum.

The bottom of the drag was filled with coke connecting with suitable openings provided between the drag and the bottom board, after which the drag was filled with sand and rammed flush with the top or joint. A straight edge with a ¾-in. step at each end was employed to sweep a foundation on which to set the pattern. A level was tried on the top flange of the pattern and the necessary minor adjustments made to insure that the pattern was resting perfectly level. This precaution was taken for various reasons, but principally as a check or gauge by which the core-box could be lined up later on to insure an even metal thickness on the side walls of the casting. Sand was then shovelled around the lower flange of the pattern and rammed firmly to withstand the pressure of the metal incident to pouring, after which a flat parting was made.

The first cheek then was put on and rammed full of sand. A parting was made all around at the line indicated at *D* in Fig. 2. The second cheek, provided with suitable chucks for carrying the sand, was set on next, rammed full of sand, and a parting was made flush with the top surface of the upper flange. The cope was plain and flat. Four gate pins were set while ramming, two at diagonally opposite corners, designed to connect with the bottom flange, and two others at the remaining corners on the top joint. Each gate was connected to the mould opening by two branch gates. One of the bottom plates is shown cut in the drag (Fig. 3).

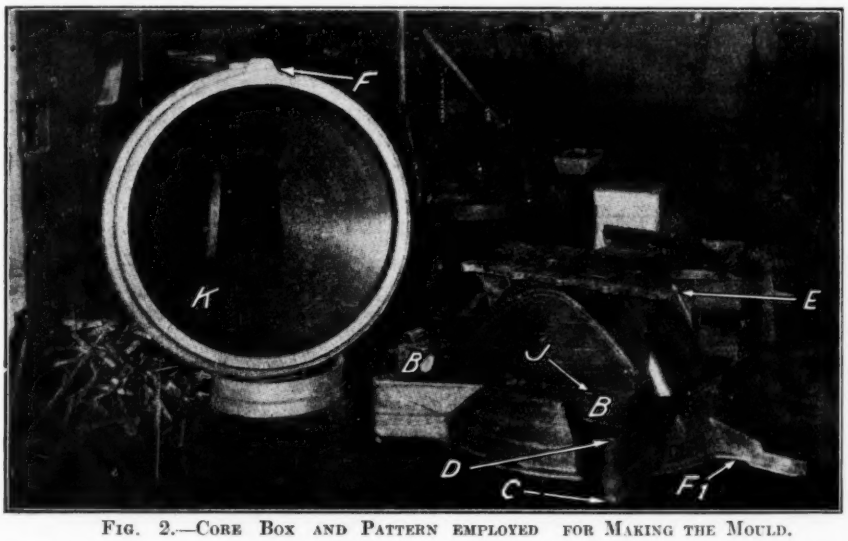

FIG. 2.—CORE BOX AND PATTERN EMPLOYED FOR MAKING THE MOULD.

To remove the pattern from the mould, the cope was lifted off and set on one edge on blocks. Two long clamps having one end resting on the floor and the other end against the upper edge of the cope prevented it from falling over. The rectangular flange with the attached brackets was then

FIG. 3.—DRAG MOULD WITH GREEN SAND CORE BUILT UP AND FOUR DRY SAND BRACKET CORES IN PLACE.

drawn out of the sand, after which the upper cheek was lifted off and set on a pair of horses. While in this position the four square core prints, two of which are indicated at *B*, *B* in Fig. 2, were removed and replaced by the cores provided for that purpose. Referring to Fig. 1 it will be

* Extracted from a recent issue of "The Foundry."

seen that the bosses and brackets made by these cores are right and left hand. All the cores were made from one box by adopting the simple expedient of providing two loose pieces in the box. To obviate the danger of setting a right-hand core in a left-hand print, or *vice versâ*, each core print was provided with a triangular gap at the bottom of one corner, as shown at *J* in Fig. 2. A similar piece cut out of the print side of each core and at the proper corresponding corner insured that the cores would be set in their proper relative positions.

The next step was to set the upper cheek back in its place, shift the lifting chains to the handles of the lower cheek and lift them both together and set them on the horses. The pattern was then drawn out of the drag and set aside. To form the inside part of the mould the core-box, shown at *K* in Fig. 2, was employed. This core-box was made of wood, heavy and rigid, and turned accurately to conform to the inside shape of the casting. The lower flange was made to fit closely in the impression left by the pattern. The lug *F* on the core-box corresponded to the lug *F*1 on the pattern, and was a guarantee that the rectangular section of the core would come in its proper relative position when the mould was assembled.

The core-box was set on the drag as indicated and tried with a level to correct any minor irregularities. It then was rammed full of sand, rapped, lifted off, and set aside. The inside and outside of the mould were finished carefully, nailed wherever necessary, and brushed with plumbago. After setting the four bracket cores *A*, *A* in Fig. 3, the mould was reassembled, clamped, and poured. Each one required a moulder's full time for four days.

To anneal the large castings special square frames were cast. An iron bottom plate was placed on several rows of bricks built two-high. The casting was then run in on the charging car and set on the plate, after which the frames were placed around it and packed full of mill scale.

A New Hardness Testing Machine.

This machine is a development of the Brinell method of determining hardness, the difference being not in principle but in the use of very small balls with correspondingly small loads. The machine is the outcome of investigations made in the Research Department, Woolwich, with the object of evolving a means for determining accurately the hardness of thin specimens which cannot be subjected to the pressure of any of the ordinary hardness testing machines, because of their small size. It has been shown that in order to obtain the true hardness number the thickness of the specimen should, as a rule, be at least seven times the depth of the impression.

The Brinell test, as usually applied with a ball of 10 mm. dia. and a load of 3,000 kilos., is unsuitable for thin specimens, which would be squeezed out between the ball and the support if the latter were hard and pressed into the support if it were soft. With a 10 millimetres ball the specimen should not be less than one-tenth of an inch in thickness. With the "small-ball" machine, however, the hardness of material one-hundredth of an inch or even less in thickness may be determined accurately.

Such articles as thin-walled tubes and other hollow forms may be tested without internal support; loaded small-arm cartridge cases may be tested without removal of bullet or charge; cutlery blades, which would be disfigured by a large impression, even if the thickness of the article would permit of the ordinary test, may be tested by an impression so small as to be imperceptible to the unaided eye; the hardness of wire can be tested at successive stages of drawing; case-hardened work, the hard skin of which is too thin to be tested by the ordinary Brinell method, can be quite successfully dealt with; the hardness of a cutting tool may be determined close to the cutting edge, the impression produced being so small that the tool is not damaged or affected in any way. Tests may also be made on very small areas of larger objects in which the hardness may vary in different parts.

As the load is applied by dead weight which can be checked by direct weighing at any time, it is practically impossible for any error of loading to creep in. The load is accurate, however large or small it may be.

The first machine was in continuous use during the war, and was the subject of a secret patent granted to Messrs. Craig, Moore & Mather, which, however, has now been published, and, by permission of the War Office, the rights of manufacture have been acquired by Messrs. Alfred Herbert, Ltd., of Coventry, from the inventors.

The balls used in ordinary practice are 1 and 2 millimetres in diameter, with loads up to 50 kilogrammes; balls of 5 millimetres diameter are supplied for testing extremely soft material. The hardness numbers are calculated in precisely the same way as the ordinary Brinell test, the load being divided by the area of the impression, and are directly comparable with the usual Brinell numbers when a load proportional to the square of the ball diameter is employed. The diameter of the impression is measured by a microscope of suitable power, which has been designed especially for the machine.

Description of the Machine.—The machine consists of a base plate which supports two threaded columns. The table for the reception of the specimens to be tested is carried by these columns, and is adjustable up and down by hand-wheel, so as to

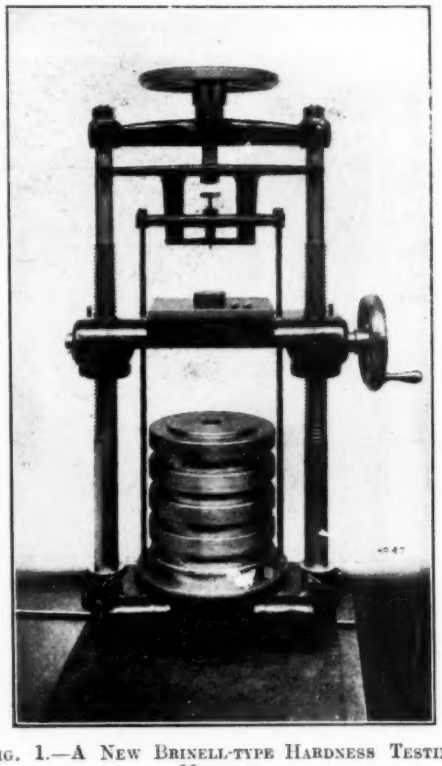

FIG. 1.—A NEW BRINELL-TYPE HARDNESS TESTING MACHINE.

set the table at the required height. The base plate is furnished with levelling screws.

At the top of the column is mounted the cross head, in the centre of which is a fine pitch, non-rotating screw, which can be raised and lowered by a hand-wheel provided with ball-thrust bearing. The lower end of the screw carries a suspension stirrup, which is prevented from rotating by arms bearing against the columns, and from this suspension stirrup is hung a loading stirrup to the upper portion of which is attached the ball-holder, while the lower portion carries the weights.

The connection between the two stirrups consists of a spherical surface in the loading stirrup, bearing in a hole in the other, so that the one hangs from the other. The friction of the spherical surface in its hole damps out any pendulum action.

The upper hand-wheel is then turned back to take the weight off the specimen, which can then be removed and the diameter of the impression measured, and from this the hardness can be determined.

Tests of Centrifugally Cast Steel.*

By George K. Burgess.

In 1918 the American Bureau of Standards had occasion to examine several hollow, steel cylinders made under the direction of W. H. Millspaugh by his centrifugal casting process.

The cylinders were cast in a machine revolving about its horizontal axis. The outer surfaces of the castings, of walls from 3½ in. to ½ in. thick, were thus against the mould and turning faster than the free inner, cylindrical surface, which was last to freeze. The outer surfaces were fairly smooth, but the interior surfaces were rough.

The results, comparing the several grades of steel in the condition as cast and after heat-treatment, are of considerable interest as indicating what may be expected from this method in the production, for certain shapes, of sound steel, *i.e.*, free from physical defects and chemical segregation, and thus with practically no waste material to discard.

As will be shown, it is also a field particularly adapted to the elimination of forging and boring operations, and the substitution for the former of heat treatment to produce the desired characteristics in the resulting product.

Dimensions and Tests of Castings.

In all six castings were examined, samples from which were subjected to the usual mechanical tests, both transverse and longitudinal, in the condition as cast and after various heat treatments. The characteristics of the metal with respect to internal stress, density, soundness, segregation and micro-structure were also studied.

Hardness and Chemical Surveys.

Results of the radial surveys for chemical analysis show that there is a gradual increase in carbon from the outside to the inside surface for all castings this increase ranging from 0.02 to 0.09 per cent.; it appears to be roughly proportional to the carbon content, or the percentage variation in carbon remains practically constant. The nickel and phosphorus appear to follow the carbon very closely in their behaviour as to segregation; manganese and silicon, on the other hand, are nearly constant across the radial section; while sulphur, although somewhat erratic, in general is distributed similarly to carbon, as is also copper, although present in quantities less than 0.10 per cent. The hardness surveys, Brinell and scleroscope, follow closely the chemical segregation, the higher numbers occurring on the inside layers. A hardness examination with the scleroscope made midway along a longitudinal section the length (72 in.) of casting No. 1 at 3 in. intervals shows a gradual increase in hardness from one end to the middle, 24.2 to 25.3, and then nearly uniform hardness for the second half.

Density.

A narrow circumferential strip 2 in. long, 1 in. broad, and ¼ in. thick was cut from the outside and from the inside of a transverse ring from the nickel steel casting No. 3 and from the low carbon casting No. 4 and used for determination of density. The results show the density to be steady at 7.834 grams per cu. cm. at 23 deg. C.

Stress Across Section of Tubes.

Three concentric rings, $\frac{3}{8}$ in. wide (radially) and ½ in. thick (longitudinally), were cut from the No. 4 casting (low carbon electric furnace steel, annealed)—one ring from the outside, one midway, and one from the inside of the cylinder. Accurate measurements were made of the outside and inside diameters of each ring, the distance between diametrically opposite punch marks and the distance between three sets of punch marks 2 in. apart, tangentially. A cut was then made (by a hand hack saw) midway between the 2 in. tangential marks and at an angle of 90 deg. to the diameter measured. When split thus the outer ring contracted visibly, but the middle and inner rings appeared to undergo no change. Similar rings were cut from casting No. 5 (high carbon nickel steel, not annealed), measured and cut in the same manner as those from casting No. 4.

The measurements taken before and after cutting these concentric rings, and the amount of expansion or contraction in each case indicate the nature of the stresses in the outer, middle and inner zones. A rough computation gives the compression at outside ring of casting No. 4 as 48,000 lb. per sq. in., and for No. 5 the compression at outside ring is 31,000 lb. per sq. in., and tension at inside ring is 47,000 lb. per sq. in. These internal stresses are of the order of the elastic limits of the material, and, as would be expected, the outer zone of the casting is in compression.

Heat Treatment and Mechanical Properties.

The improvement of these castings by heat treatment, in Table I., are given the details of the treatments to which material from their castings were submitted, and in Table II. are grouped the mechanical properties associated with the respective treatments. It should be recalled that castings Nos. 1, 3, 4 and 7 were annealed as a whole before any tests were made on them, while castings Nos. 5 and 6 were examined first in the condition as cast. The test pieces from 3A and 3I were from pieces of the same casting 60 in. apart.

Table I—Heat Treatment of the Various Sections. All Specimens Cooled in Air.

Sample*	Temperatures and Time of Heating. Heated slowly in air deg. C.	Then cooled and held hr.	Temperature when quenched, deg. C. First	Second	Quenching medium.	Drawn 30 min. deg. C.
1 N	800	½	—	—	—	—
1 Q	800	½	800	—	Water	600
3 N†	900	3	—	—	—	—
3 Q	900	3	850	—	Oil	650
4 N	915	½	—	—	—	—
4 Q	915	½	920	—	Water	460
4 QQ	915	½	920	885	Water	440
5 N	750	1½	—	—	—	—
5 Q	750	1½	760	—	Oil	700
6 N	850	½	—	—	—	—
6 Q	850	½	830	—	Water	680
6 QQ	850	½	830	790	Water	690
7 Q	880	1	880	—	Water	510
7 QQ	880	1	885	845	Water	435

* Samples 1, 3, 4, and 7 annealed; samples 5 and 6, as cast; N signifies normalised; Q, quenched and drawn; and QQ, double quenched and drawn.
† Specimens from A and I sections of No. 3 same treatment.

Table II—Mechanical Properties Resulting from Respective Heat Treatments.

C and Ni per cent.	Sample No. †	Yield point Tons per sq. in.	Max. stress Tons per sq. in	Elong. on 2 ins.	Reduction of area per cent.
	1 X	24.2	40.7	10.5	12.1
C 0.44-0.50	1 Y	23.9	40.4	9.5	8.9
Ni 2.32-2.39	1 Tx	25.2	40.0	5.5	7.5
	1 N	30.1	41.5	8.5	12.5
	1 Q	39.1	39.7	4.5	11.5
	1 Qx	40.8	46.9	6.5	14.0
	3 AX	24.0	40.1	7.5	12.1
C 0.32-0.34	3 AY	21.6	36.4	16.5	22.0
	3 ATx	22.6	34.9	26.0	42.5
Ni 2.66-2.75	3 AN	26.7	42.7	16.0	29.3
	3 AQ	30.1	43.7	21.5	47.4
	3 AQx	31.3	40.3	20.5	42.0
	3 IX	23.4	39.6	14.8	19.3
C 0.30-0.35	3 IY	21.6	36.5	27.0	41.8
Ni 2.66-2.76	3 IN	27.0	39.8	9.5	18.5
	3 IQ	28.8	42.6	21.0	29.9
	4	17.9	27.5	16.5	10.4
C 0.16-0.21	4 N	21.2	29.0	11.5	18.9
	4 Q	26.8	35.4	13.0	20.3
Ni None	4 QQ	24.6	32.4	12.5	24.5
C 0.63-0.72	5	21.4	37.9	2.5	1.2
	5*	29.3	37.8	1.0	1.0
Ni 2.90-2.94	5 N	34.6	57.6	6.5	5.4
	5 Q	43.0	51.5	16.5	21.7
	5 Q*	41.2	50.5	7.5	10.5
	6 X	21.2	36.8	17.5	21.5
	6 Y	21.4	36.4	17.5	28.5
C 0.31-0.35	6 Tx	22.3	37.1	16.5	22.0
Ni 2.69-2.81	6 N	26.8	39.1	14.5	22.0
	6 Q	37.3	44.9	16.5	26.5
	6* Qx	37.9	46.5	12.5	24.5
	6 QQ	31.2	41.1	23.0	44.0
C 0.22	7 N	17.0	28.6	35.5	52.5
-0.25	7 Q	30.9	42.6	18.3	39.2
Ni None	7 QQ	25.8	35.3	27.3	47.7

*Transverse test pieces, others are longitudinal.
† x Inner zone; T, tangential; Q, drawn and quenched; Y, outer zone; N, Normalised; QQ, double quenched and drawn.

* Abstract of a Paper presented before the Philadelphia Chapter of American Society for Steel Treating, February 16, 1921.

An examination of Table II. shows that most samples show good tensile strength for their composition and treatment, and also that there is no marked difference in values for longitudinal and transverse specimens. The values for the Izod shock test were somewhat erratic. The advantages of heat treatment, notably of the double quench and draw, in improving both the resistance to shock and especially the ductility as measured by reduction of area are strikingly manifest.

Certain of these treated steel castings would appear to compare very favourably in their properties with those of forged material of the same compositions. For example, the ordnance requirements for gun forgings are: Elastic limit, 29 tons per sq. in.; tensile strength, 42.4 tons per sq. in.; elongation, longitudinal 22 per cent., transverse 18 per cent.; reduction of area, longitudinal 35 per cent., transverse 30 per cent. These are probably more than met by casting No. 6QQ (C = 0.33, Ni = 2.75 per cent.), and almost met by others, such as 3AQ, 31Q (C=0.32, Ni= 2.70 per cent.). Again the properties of the casting (C = 0.23 per cent.) are high for steel castings of that composition, and in the treated condition are superior to many of the results on hot rolled 0.20 to 0.25 carbon steels, and indeed are comparable to those of cold rolled steels of this grade.

Macrostructure and Microstructure.

It is of interest to note there appeared no flaws or visible defects, other than small blow holes near the inner surface, in the preparation of any of the test pieces for physical or chemical examination. The blowholes noted were always about 1/16 in. from the inner or free surface of the casting. No hard spots were found in any of the castings. Just next the inner surface of all castings there is a layer not over 1/16 in. thick which appears to contain nearly all the physical and chemical discontinuities.

Sulphur prints and cupric-ammonium-chloride etchings were made on transverse sections of each casting. Specimens for microscopic examination were cut from transverse, radial (longitudinal) and tangential sections of each casting as received and from transverse sections of the heat treated bars, after normalising, quenching and drawing, and double quenching and drawing.

The most serious of the low carbon areas were found in castings Nos. 3A and 6. These areas are not completely eliminated by normalising and persist even after quenching and tempering, but have been almost completely eliminated by the double quench and draw treatment. The normalising treatment, for the most part, greatly refines the structures, while quenching and drawing produces a sorbitic structure with partially diffused ferrite. Structures after the double quench and draw compare favourably with those of large heat treated steel forgings.

Book Review.

GIESSEREIMASCHINEN. By Emil Treiber.—Berlin: Walter de Gruyter & Co., Gentinerstrasse 38, W.10. Price 1s. 6d.

We reviewed in our issue for June 9 a German book dealing with moulding materials used in iron and steel foundries, and with machinery employed for preparing these materials for the moulder's use. The present little treatise slightly overlaps the former book in the first 28 pages, but its bulk (about 120 pages) is devoted to foundry machinery in general, and to moulding and fettling machines in particular. The types of moulding machines and gear dealt with are (1) hand-moulding machines; (2) moulding presses; (3) vibrators or shakers and similar machines; (4) moulding machines for special purposes, like pipes, pots, toothed wheels; (5) core-moulding machines; and (6) pneumatic rammers. The types of fettling machines and gear described are:—(1) Sand blasting; (2) centrifugals; (3) rattling drums; (4) emery discs; (5) pneumatic chisels. Finally, elevators, conveyors and lifting appliances are dealt with briefly in a short appendix. These are more fully described in the previously reviewed German book. The one now under review is fully illustrated (69 figures) and now appears in its second edition.

A Foundry Exhibition.

Mr. W. G. Hollinworth, Secretary of the Institution of British Foundrymen, has handed to us a letter which he has received from the President of the Association Technique de Fonderie de Liége (M. J. Leonard, 51, Quai du Canal, Herstal, Liége), of which the following is a translation:—

"The Belgian foundry industry, especially in Liége, is now sufficiently developed to allow the Technical Association of Foundrymen to re-establish itself and to carry on its normal activities. This Association was founded in 1911, and has enjoyed an active existence, and this year proposes to celebrate its tenth anniversary by holding, towards the end of September, a general congress and foundry exhibition, similar in every respect to the one held at Paris in 1913 and American ones.

"A very large number of Belgian founders and foundry supply companies (moulding machines, crucible furnaces, etc.) have promised support, so much so that there is reason to believe that a success, at least equal to the Paris exhibition, is assured.

"We should be delighted to welcome to this congress respresentatives of the foundry industry from Allied countries, especially Great Britain, whose sympathy during the war was greatly appreciated by most of us.

"In view of the above, we would ask you to be so kind as to go into the matter and ascertain whether your members would be agreeable to form a party, or to come along individually, to take part in this convention. Additionally, we should be obliged if you could be so kind as to introduce to us an authority on matters foundry, who would be willing to address the conference in French on a technical subject. The scope of the paper will be left to your choice, but we should require this to be definite one month before the meeting in order that it may be incorporated in the congress programme.

"We trust that the memory of our good town of Liége will induce you to make a special effort to help us in making a success of our enterprise. Looking forward to seeing your Association represented at Liége."

A postscript gives the information that the exhibition will open on September 18 and close on October 3. The congress will commence on Sunday, September 18, and will last three or four days. Visits to foundries and works will be included in the arrangements. Stands will be let at from 30 to 40 francs per square metre.

American Foundrymen's Association

At a meeting of the executive committee of the American Foundrymen's Association, held in New York, May 28, it was decided to postpone the annual convention and exhibition from October, 1921, to the spring of 1922, when it probably will be held either in April or May.

GRINDING CRACKS.—MM. Guillet, Galebourg and Beuret, writing in a recent issue of "Revue de Metallurgie," summarise their investigations on this subject by stating that truing-up cracks are above all due to heat developed during grinding. Such cracks can be obviated by an ample supply of cooling water, associated with a satisfactory circumferential speed (of the order of 400 r.p.m. for articles of $\frac{5}{8}$ in. dia.). This heating is, no doubt, responsible for a distinct softening on the surfaces to be "trued-up." In this case, also, for similar reasons, by correct grinding speeds, softening can be practically eliminated.

ELECTRIC STEELWORKS DESTROYED.—The "Journal du Four Electrique" states that the works of the Société des Hauts-fourneaux et Forges d'Allevard, at Allevarde (France), has been destroyed by an avalanche, which crushed the buildings just before the electric furnace was to be tapped. Four electric furnaces, together with transformers and overhead cranes, were totally destroyed. Fortunately no lives were lost.

Trade Talk.

THE "Aquitania" (burning oil) has beaten the "Mauretania" (burning coal) in a race across the Atlantic by the big margin of 29 hours.

THE SUNDERLAND FORGE AND ENGINEERING COMPANY, LIMITED, have taken land at King's Dock, Swansea, where they propose erecting branch works.

IT is reported that the Swansea Harbour Trust is considering the closure of the North Dock in consequence of the considerably reduced volume of trade.

S. P. AUSTIN & SONS, LIMITED, have closed down their Wear Shipyard, Sunderland, for an indefinite period. The ship repairing department will, however, remain open.

THE Japanese Railway Department has decided to use heavier rails on the Tokyo suburban lines. Those now in use are from 60 to 75 lbs. per yard. It is proposed to substitute 100-lb. rails.

HEAVY damage was caused by an outbreak of fire in the Lilybank Foundry, Dundee, of the Caledonian Shipbuilding and Engineering Company, Limited, last week. The dressing and pattern shops were practically burnt out.

A NEW company has been formed at Bombay under the title, Indian Steels, Limited, with a share capital of Rs. 3,500,000 (£350,000 at Rs. 10 to the £) for the manufacture of high-quality steels, such as tool steel, spring steel, etc.

MESSRS. G. A. HARVEY & COMPANY (London), LIMITED, Suffolk House, Laurence Pountney Hill, E.C.4, inform us that they have revised their list of Stamped Steel Rain Water goods in all gauges. The new list is No. 249.

THE civil engineering and contracting department of Sir W. G. Armstrong, Whitworth & Company have secured, in competition, the contract for the Apapa Wharfage Scheme, Lagos Harbour, Nigeria, from the Crown Agents for the Colonies.

A FIRM of ironfounders in the South Bank area of Middlesbrough has restarted a number of bricklayers on their blastfurnaces, and it is hoped within a fortnight of the settlement of the coal trade dispute to have practically the whole of their works in operation.

MESSRS. COX & DANKS, 168, Regent Street, London, W., have purchased some 10,000 tons of cast-iron bomb bodies and cast-iron shells, which they are now offering for sale, as well as some stocks of pig-iron, apparently from Ministry of Munitions sources.

THE Swedish National Fair is to be held from July 4 to 10 next at Gothenburg. The main groups include (1) iron, steel and metals; (2) machine tools; (3) iron products and small tools, (4) metal products. The postal address is Svenska Mässan, Gothenburg, Sweden.

ACCORDING to the "Norges Handelstidende," the Norwegian Currency Differential Committee is considering a scheme for the protection of industry by a system of multiplying the present Customs rates by co-efficients expressing the difference between the currencies

IN the Australian House of Representatives the proposal moved by the Labour Party to increase the present duties on pig-iron, namely, 20s. a ton British preference, 30s. a ton intermediate tariff, and 40s. a ton general tariff, to 30s., 45s., and 60s. respectively, has been defeated.

PIG-IRON amounting to 415,808 was produced in Nova Scotia in 1918, and 512,377 tons of steel ingots. Total value of iron and steel products in 1919 was approximately $19,000,000. Other minerals produced, in smaller quantities, include gold, gypsum, manganese, antimony, copper and lead.

AT the meeting of the Association of British Chambers of Commerce last week, a resolution was passed urging upon the Postmaster-General the desirability of instituting a uniform system of charges to telephone subscribers, based upon average distances from the nearest telephone exchange.

IT is reported from Luxemburg that, as a result of the industrial crisis and the cheaper supplies of food, combined with the wish to discharge as few workmen as possible, the iron and steel companies in general are reducing time and piece rates of wages, or abolishing the bonuses hitherto paid.

ONE of the Ford furnaces (U.S.A.), in April, broke all previous records, making an average of 503 tons of pig-iron per day (silicon 2.06 and sulphur 0.028 per cent.) on 2,021 lbs. of coke and 71 lbs. of flue dust per ton of iron. This is claimed as a record for the production of No. 2X foundry iron.

STATISTICS compiled by the U.S. Geological Survey show that the production of primary metallic zinc from foreign and domestic ores in 1920 amounted to 463,000 tons, as compared with 465,743 tons in 1919. The exports of zinc in 1920 amounted to about 114,500 tons, compared with 146,297 tons in 1919. The apparent consumption of primary zinc during 1920 was about 324,000 tons, compared with 323,964 tons in 1919 and 423,792 tons in 1918.

THE Soviet Government has published, in its German trade edition, a list of 12 mines or mineral fields in Asiatic Russia, for the working of which concessions to foreigners may be granted. Five of these are coalfields, three iron-ore fields, and the rest fields of graphite, copper, wolfram, tin, and sulphate of soda.

THE London and North-Western Railway are experimenting with a new type of engine which it is claimed will revolutionise the present system. An electric turbine will take the place of the present motive power, and in addition to attaining the much-desired velocity, it is stated running costs will be considerably reduced.

MILLARS' TIMBER AND TRADING COMPANY, LIMITED, Pinners' Hall, Great Winchester Street, London, E.C.2, have recently opened an extensive machinery depôt at Kirtling Street, Battersea, where they are showing their specialities in concrete mixers, wagon loaders, steam shovels, and other labour-saving appliances.

THE Report presented to the members of the Birmingham Metallurgical Society at the annual general meeting (Mr. A. Spittle, president, in the chair), showed that the Society's activities during the last session had been progressive. The membership at that date had reached the total of 874, showing a net gain on the previous session of 44.

A REPORT from Budapest states that negotiations are in progress between the Rimamurány Ironworks Company and the Salgó-Tarján Coalmining Company for a working agreement. The two concerns have been co-operating for some time. There is now a scheme under consideration for raising the share capitals of both companies and exchanging the new shares.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, LIMITED, 170, Piccadilly, London, W.1, have established an Indian branch at 8, Clive Street, Calcutta. Messrs. G. & A. Angus, Rangoon, and the United Engineers, Limited, Singapore, have been appointed the company's agents for Burma and the East Indies respectively.

MESSRS. SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, have just finished the building and engining of a cargo ship, the s.s. "Dandolo," the trial trip off the Tyne taking place on June 10. The ship is to carry 8,300 tons on a draught of 25 ft. 4½ in. She is of the shelter-deck type, and has been built to the highest class of Lloyd's.

THE ballot on the proposal to continue the levy of 1s. 6d. per week for 13 weeks to provide extra donation benefit for members of the Amalgamated Engineering Union is as follows: In favour, 61,990; against, 55,157; majority in favour, 6,833. The membership now totals 449,191, a reduction during the past month of 1,227. Unemployed members total 112,319.

SHEFFIELD and Derbyshire ironfounders and steelmakers are considerably perturbed by the placing of a contract with a French firm for the supply of pipes, bends and special castings to the Sheffield Corporation in connection with a balancing tank at one of the city's reservoirs. The amount of the French tender is £719, while the lowest British tender was £1,291.

THE Leeds branch of the Industrial League and Council, which has recently become the autonomous centre for Yorkshire, has organised for the week-end at Ilkley a conference of employers and employed, at which the subject for consideration will be "Finance in Relation to Industry." Mr. C. E. Warren (ex-president, Incorporated Leeds Law Society) will preside.

PART of the investigations of the Engineering Trade Joint Committee has been completed. The members include representatives of the Employers' Federation and of the Trade Unions, and their tour of Continental engineering centres has been a revelation of the efficiency of the organisation of the trades in Belgium, Holland and Germany, and the anxiety and willingness to increase outputs.

A FURTHER step towards the standardisation of automobile, motor cycle and cycle parts has been taken by the British Engineering Standards Association in the formation of seven sub-committees to undertake the following sections of the work:—(1) Nomenclature; (2) steel; (3) small fittings; (4) electrical fittings; (5) shafts and shaft details; (6) wheels, rims and tyres; (7) cast iron.

THE new Weight and Measure Law has now formally been promulgated by the Japanese Government, whereby Japan becomes one of the metric countries. Within the five years beginning with the date from which the Law takes effect all public works, Government offices, schools and large factories will be made to adopt the metric system, while the general public will be given 20 years' grace.

IN order to protect consumers of iron and steel and the mining industries in Spain, the Ministro de Fomento has been authorised to fix the prices at which coal and metal products are to be sold by the mining and manufacturing concerns respectively. The iron and steel concerns are to use Spanish coal for their works, and the Ministro de Fomento is to enforce this provision as far as possible.

WITH a view to freeing the French iron and steel industry from dependence on Westphalian coke, experiments are being conducted in the coking of Saar-Lorraine coal. If the experiments are successful a great impetus will be given to the exploitation of the extension of the Saar basin into Lorraine.

THE Compañia Española Minas del Rif has declared for 1920 a dividend of 4 per cent. ordinary plus 6 per cent. complementary, or 10 per cent. dividend in all, on the shares already issued, representing a total capital of 20,850,000 pesetas (£834,000 at par). The exports of iron ore totalled 301,394 British tons.

THE Council of the British Chamber of Commerce in Brazil have resolved to give their support to the organisation of a British Exhibition to be held in Rio de Janeiro in the Centenary Year, 1922, which might form part of any international exhibition to be arranged for that year. This is the first exhibition of any magnitude which has taken place in Brazil since that held in Rio in 1908.

IN answering a question in the House, the Postmaster-General stated that, in view of the widely-extended banking system in this country, and the general use of bank cheques and postal orders for remittance purposes, he does not think there would be any substantial demand for postal cheques, especially having regard to the high fees which it would be necessary to charge to cover the cost of the service.

A TELEGRAM from the Commercial Secretary to His Majesty's Legation at Buenos Aires, states that the Bridges and Roads Department are inviting tenders to be presented by August 16, for 280 tons of rolled steel, and 10 tons of cast steel. Local representation by a resident agent is essential. Particulars on application at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1.

A REPORT from the Hague states that the Holland Steelworks and Rolling Mills of Rotterdam are unable to complete the various plants in course of erection owing to the want of funds. The management, however, does not recommend the concern to go into liquidation, as such a procedure would involve the shareholders in serious losses. Should the requisite funds not be forthcoming all building operations will be stopped.

THE Bohemian works have some difficulty in disposing of their output. Thus, for instance, the Witkowitz works, in order to keep their men employed, are obliged to place certain brands of pig-iron and rolled products in stock. The Trzynietz ironworks have not sufficient work for their men, and unless some Government orders are forthcoming, they will be obliged to discharge a large number of men. The Kladno works of the Prague Iron Industry Company have for some time been working at a reduced rate

A NEW organisation, under the title of the Federation of British Propaganda Societies, has been formed, the object of which is to co-ordinate the work of Propaganda Societies and, as far as possible, prevent overlapping. Already about fifteen Propaganda Societies have expressed their willingness to join. His Grace the Duke of Northumberland has consented to act as President, and Sir Henry Birchenough, K.C.M.G., etc., is the Treasurer. The General Secretary is Mr. David Gilmour, O.B.E., Sicilian House, Southampton Row, London, who will be willing to give further information to any of our readers.

A COMMUNICATION has been received from His Majesty's Trade Commissioner at Sydney (Mr. A. Simpson), to the effect that Messrs. Hoskins Iron & Steel Company, Limited, who at present own large iron and steel works at Lithgow, New South Wales, have purchased 380 acres of land at Port Kembla, near Wollongong, New South Wales, where the company intend erecting additional steel works. It is understood that the total outlay in connection with these new works will be in the vicinity of £2,000,000, and that it is intended to purchase as much of the plant and equipment required as possible from the United Kingdom.

THE representatives of the National Light Castings Ironfounders' Federation, the National Union of Foundry Workers, the Central Ironmoulders' Association, the General Ironfitters' Association, and the Joint Committee of Light Metal Trade Unions have agreed to recommend to their respective constituents the following terms of settlement in regard to the wages dispute, viz. :—(*a*) A reduction of 3s. per week from the wages of time-workers and of 7½ per cent. from the wages of piece-workers, to take effect in respect of work done on and after Monday, July 4, 1921; (*b*) a further reduction of 3s. per week from the wages of time-workers and of 7½ per cent. from the wages of piece-workers, to take effect in respect of work done on and after Monday, August 1, 1921; (*c*) the further consideration of the reduction of 12½ per cent. from the wages of time-workers and of 7½ per cent. from the wages of piece-workers to be meantime postponed.

Company News.

Kayser, Ellison & Company, Limited.—Half-yearly dividend on 6 per cent. preference less tax, has been declared.

Cleveland Bridge and Engineering, Limited. — Interim dividend at rate of 5 per cent. per annum, free, on ordinary shares for half-year, payable June 23.

John Brown & Company, Limited.—Final dividend recommended of 5 5-16 per cent., making, with interim of 4 1-6 per cent., 10 per cent. for year to March last.

Wm. Foster & Company, Limited. — Net profits, £7,614 17s. 9d., and £16,957 was brought forward. A dividend of 6 per cent. is proposed on the Ordinary shares, placing to the reserve fund £5,000, and carrying forward £13,024.

Howard & Bullough, Limited.—Final dividend of 2½ per cent. on the ordinary shares, making 10 per cent. for the year ended May 31; £40,000 (against nil) is placed to dividend reserve, and £50,956 (against £57,207) is carried forward.

Robert Stephenson & Company, Limited.—Profit for 1920, after providing £15,000 for depreciation, was £29,951, plus £56,214 brought in, making £86,165. Dividend proposed of 5 per cent. for year, less tax, carry to general reserve £15,000, carrying forward £61,540.

Alldays & Onions, Limited. — The report shows that the amount brought forward was £18,247; the net profit was £7,111, making £25,358. After deducting interest on debentures and allowing for balance of loss on special expenditure account and amounts written off, together £16,530, there remains £5,248.

John Hickton & Company, Limited.—Capital £6,000 in £1 shares (1,500 5 per cent. cumulative preference, free of income tax). To take over the business of manufacturers of nails, chains, and general hardware carried on by J. H. W. Hickton, Alice M. W. Melley, A. Smart, and H. Greaves at Halesowen, as "John Hickton & Company." Registered office: Stourbridge Road, Halesowen.

Meters, Limited.—The net profit for the year ended March 31 was £27,414 (against £25,160 in the previous year), while £10,989 was brought forward. A final dividend on the ordinary shares is proposed of 6 per cent., less tax, making 8½ per cent. for the year, and in addition a bonus of 4d. per share, free of tax. The sum of £3,000 is added to reserve, while the staff pension fund is credited with £2,000, carrying forward £8,825, subject to E.P.D. and Corporation Tax.

Gazette.

THE FYLDE BRASS FOUNDRY, LIMITED, is being wound up voluntarily, and Mr. J. Todd, 18, Birley Street, Blackpool, is liquidator.

MESSRS. E. E. CLARKE and H. Schofield, electrical engineers and contractors, 4, Alhambra Buildings, Morecambe, have dissolved partnership.

MESSRS. H. Y. FOWLER and A. E. Jones, electrical engineers, 1a, Menzies Street, Liverpool, have dissolved partnership. Mr. H. Y. Fowler continues.

THE LEAMINGTON CASTING COMPANY, LIMITED, are being wound up voluntarily. Mr. E. F. Peirson, 17, Hertford Street, Coventry, has been appointed liquidator.

MESSRS. H. JONES and N. A. Usmar, electrical and general engineers, 80 and 49, Ebury Mews, Eccleston Street, Victoria, London, S.W.1, trading under the style of Henry Jones & Company, have dissolved partnership. Mr. H. Jones will continue the business.

A MEETING of the creditors of Thomas and Isaac Bradley, Limited, Capponfield Blast Furnaces, Bilston, and Red Hill Fire Brick Works, Rocester, in voluntary liquidation, was held at Birmingham on June 8, when the liquidator, Mr. T. D. Neal, presented a statement of affairs showing liabilities amounting to £147,366, and the assets estimated to realise £145,987. Mr. Neal said the losses incurred were due largely to heavy purchasing contracts turning out against the company. He expressed the opinion that given reasonable trade conditions the furnaces should prove a good paying concern. In his opinion an effort should be made to restart them as soon as pig-iron could be produced at a reasonable profit. The meeting was adjourned for a month so as to enable a committee of eight creditors to consider whether or not to continue voluntary liquidation or to support a petition for compulsory winding-up.

MR. WILLIAM EDWARD HINDE, of the Penarth Pontoon, Slipway, and Ship-repairing Company, has been unanimously elected to the seat on the board, which has been vacant since the resignation of Mr. Lewis R. Turnbull. Mr. Hinde is well known in Cardiff, and is the head of the firm of Messrs. W. E. Hinde & Company, shipowners.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Question of Apprenticeship.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I am sure every reader of your JOURNAL will appreciate Mr. Marsh's letter in your last issue. It is indeed gratifying to see that Newport is giving such a lead in coping with the lack of intelligent boys in the foundries. It is well known that my Council are earnestly taking this matter in hand, and we hope shortly to offer to every technical institute a well-considered practical plan whereby boys can be attracted to the foundry classes. The essence of which must be that they will have to be made interesting and devoid of all academic nature.

Foundry boys are as keen and as anxious to be of the same status as the engineering apprentice, and if properly handled will look upon their career with equal pride. Classes and lectures should be given in a proper style and practical in effect. The lad should be taught not only how to do anything, but also why it is best done in that particular way. The subjects should be made interesting and understandable, and, above all, given by men who are accustomed to handle foundry boys. Attempts should not be made to instil masses of indigestible facts into the boy's mind, this practice very often being the reason of the poor attendances.

It should be remembered that the mere attendance shows that the lad has not been fully equipped for the career he has taken up; he has not been able under our present educational and economic systems to train himself properly, but his willingness after a hard day's work to study should encourage his employer to make it worth his while to become more efficient.

The future of our foundries entirely depends upon how these lads are trained. They are the moulders of the future, and every technical institute should take advantage of the help and assistance my Council can give in formulating their foundry class syllabus, and foundry proprietors should allow time off (on pay) to attend the classes. We shall then go a little way towards reaching the great example set us by Austria and Germany in their apprentice-training system.

In the past it has not been considered necessary to attempt any training of foundry hands; indeed, old-fashioned proprietors looked upon it as somewhat dangerous to do so; it was considered that employers could get all they wanted by "bringing up" men on the works. Such a fatal policy has without doubt caused the present dearth of skilled moulders. Not only the present but future competition will call for workmen of the best ability, training, and skill that can be produced so as to maintain the efficiency of the foundry produce. If this is driven home to very proprietor and every workman we need have no qualms for the future.

The youthful mind is readily influenced. Let us therefore see to it that our lads have the best possible chance of being trained, and they will be found to be the best paying part of the foundry.

Finally, let me appeal to the General Foundry Workers' Union to take an active part in this matter, and send representatives on to the Council of this Association. They have very much to gain thereby and absolutely nothing to lose.—Yours, etc.,

THOS. VICKERS,
Secretary,
The British Cast-Iron Research Association.
Central House, New Street, Birmingham.
June 20, 1921.

We have received from Messrs. Holcroft's Steel Foundry Company, Limited, 329, High Holborn, London, W.C.1, "Concerning Steel Castings," a well-illustrated catalogue containing some brief notes as to material competitive to steel castings. Chemical analyses of their brands, together with average mechanical tests and applications form a useful section of this catalogue.

A New "Core-making" Machine.

There is no doubt that in most engineering works the foundry has been the last department to receive attention with a view to saving labour, and the old methods of work have long held good. Gradually, however, attempts at progress are being made in this direction, and one of the latest is a machine designed and patented by Messrs. Ritchie, Hart & Co., Ltd., of Mountpottinger Foundry, Belfast, with the object of getting away from the old method of running up loam cores on barrels by means of one, two, or even four men in case of large cores, turning the barrel by hand while the core-maker guides on the straw ropes and covers with loam—a truly tedious and laborious job.

In this machine, once the core barrel is put between the centres, one man completes the operation. The stopping and starting is done by the foot at any place in the length of the machine, leaving both hands free to guide the rope and put on the loam. Two or three speeds are arranged for, as it is possible to run the machine much faster when winding on the ropes than when dressing with loam. The coreboard is rigidly held in clamps, which are adjustable for any diameter of core, and consequently a perfectly cylindrical core is obtained.

Cylindrical cores on straight barrels of any length and diameter can be made on the machine, one man only being required for its operation.

The machine has been inspected at the makers' works, and favourably commented upon by some of the principals of the largest local foundries.

Personal.

MR. W. FLETCHER, late of Monks, Hall & Company, Limited, left £13,108.

SIR FRANCIS BARKER, director of Vickers, Limited, is seriously indisposed.

MR. HARRY WILSON KING, late of Birmingham, tinplate merchant, left £9,311.

THE late Mr. Thomas Richardson Dowson, of South Shields, ship repairer, left £8,007.

THE LATE SIR JOHN MCLAREN, of Messrs. J. & H McLaren, left £23,468, with net personalty £19,204.

MR. T. R. DOWSON, engineer and ship repairer, of Messrs. T. R. Dowson & Company, South Shields, left gross estate of the value of £8,007, with net personalty £5,839.

MR. R. FARQUHAR, manager of Walkers, Limited, engineers, Maryborough, Queensland, has been appointed Director of Shipbuilding by the Commonwealth Government.

PROF. WALTER MACFARLANE, Principal of the County Technical College, Wednesbury, has resigned after 25 years' service. He will retain connection with the College as Emeritus Principal.

MR. HY. WHITEHEAD, a director of Sir W. G. Armstrong, Whitworth & Company, Limited, the Whitehead Torpedo Company, Limited, who died on March 14, aged 78, left estate of the value of £201,248, of which £194,493 is net personalty.

Deaths.

MR. J. T. TULLIS has died at his residence, Kiloran, Hatfield Drive, Kelvinside. Mr. Tullis started business in Parkhead with his brother in 1891, as D. & J. Tullis, Limited, engineers, the firm ultimately migrating to Kilbowie Ironworks, Clydebank, in 1894, where the business is now carried on.

MR. JOHN HILL, who has died at Kingston-on-Thames, at the age of 71 years, was formerly an ironmaster at Middlesbrough, and had been blind for a number of years. Mr. Hill was for many years managing director of Messrs. John Hill & Company, a firm which was later absorbed by Messrs. Dorman, Long, & Company, Limited.

WE regret to announce the death on Saturday last of Sir Thos. Wrightson at an advanced age. The deceased gentleman years ago represented Stockton in Parliament in the Unionist interest. He was chief of the firm of Head, Wrightson & Company, of Stockton. He had rendered great service in the public interest, and was held in the highest esteem.

THE death occurred on Saturday at Ridding's House, Alfreton, of Alderman James Oakes, for many year chairman of the Derbyshire County Council. He was head of the firm of James Oakes & Company, one of the oldest private ironmasters and colliery proprietors in the country. On their premises paraffin oil was first discovered, and James Young, of Glasgow, made experiments which led to the use of oil as an illuminant.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Although a certain amount of confidence is felt that some solution of the fuel difficulty may soon be found, there is as yet little disposition to open out business on future account, the general idea being to still suspend buying orders until something definite transpires as to the cost of coke when furnace operations are resumed. So much depends on this factor in the cost of production of pig-iron, that both makers and consumers of the metal may be well excused for adopting a waiting policy until more definite information on the point is forthcoming. The difficulty of doing business in pig-iron at the moment is further enhanced by the practical exhaustion of stocks in makers' yards, while supplies of foundry qualities for immediate delivery are almost unobtainable. In this connection Lancashire is more especially affected, and it is a little doubtful whether founders will be able to get enough for their castings to allow them to pay very extravagant prices for iron, and there may be a tendency to use more scrap. Foreign foundry iron is reaching some of the districts at £7 per ton delivered, and this indicates that the foreign ironfounder has an immense advantage over his British competitor. In the Cleveland iron market business continues in a state of lethargy, and no movements have yet developed in the matter of prices, which, with premiums, are as follows:—No. 1, 135s.; No. 3 G.M.B., 130s.; No. 4 foundry, 129s.; No. 4 forge and mottled, 17s. 6d.; white, 115s. Makers with any foundry iron in stock are charging an export premium of 5s. per ton, but shipping business just now is only negligible.

The almost complete collapse of the steel industry will explain the existing quiet demand for hematite, but it is quite anticipated that a temporary revival is likely when fuel supplies are again assured. At all events, makers show no disposition to shade prices, which remain for both East and West Coast irons at 160s. per ton for home consumers, though it is said that offers of 145s., f.o.b., for export, might be favourably considered.

Tinplates.

During the past week only a quiet business has been passing in tinplates, the uncertainty of the labour situation and a general lack of overseas inquiries inducing an indisposition on the part of buyers and sellers alike to open up fresh commitments until future prospects are better defined. Transactions, consequently, have been almost entirely confined to sales from stock, coke primes for spot delivery making about 27s. per box, f.o.b. There is less doing in forward plates, but there is a disposition to quote for delivery after the coal settlement, the figure of 26s. basis, f.o.b., being mentioned, and it is reported that there is a good inquiry for plates for delivery over the next four months. The home demand is quieter and wasters are slower, as these are not easy to obtain. CW, 28 by 20's, are offered at 39s. 6d., f.o.b., whilst CW, 20 by 14's, are 20s., f.o.t. Quarter wasters are quieter. Current prices are:—Cokes, 20 by 14, 26s. to 27s.; ditto, quarters, about 29s.; cokes, 20 by 10, 35s. and up; ditto, 28 by 20, 51s. and up; ternes, 28 by 20, 52s. to 56s.

Finished Iron.

An outstanding development of recent movements in the markets for finished iron has been the downward tendency of prices in most sections of the manufacturing industry, culminating last week in the substantial decline in marked bar quotations of £5 10s. per ton, which brings the values of the best brands more nearly into line with the relative values of crown qualities. To illustrate the importance of this decision, it is only necessary to state that some six months back marked bars were selling at £33 10s. per ton, which, when compared with the new price just fixed, £22, shows a total reduction of rather more than a third of the then current value. This, it should be remarked, is the biggest decline in price of the material ever recorded in the history of the marked bar trade. Although, of course, temporarily suspended, some inquiries to hand inspire hopes of an early resumption of work at the bar mills, but this, of course, must entirely depend upon the course of events as regards the reopening of the collieries, now a somewhat obscure problem.

Scrap.

Taking Middlesbrough as a representative market for this class of raw material, reports from that centre indicate continued depression in the scrap trade, although in occasional circumstances works are said to be open to offers of metal providing terms are considered acceptable. Dealings, however, are mostly for stock, with a view to substitution until the blast-furnaces are again in operation, and the prices offered are correspondingly low. Works, for instance, are offering £2 10s. per ton for heavy steel scrap, while turnings make about £2 5s., delivered. Heavy cast-iron scrap for which demand should be active when the foundries are re-started, is about £6 per ton, but at the moment there is very little of this metal changing hands.

Ore.

With the entire furnace plants closed down, there is, of course, practically no market whatever for foreign ore, all the works being glutted with stocks, but under old contracts a few deliveries are still being made, over 15,000 tons having arrived at Tees ports during this month. Prices remain at pre-strike quotations, but no new business is being attempted.

Steel.

The disappointing result of the miners' ballot, showing an adverse majority for returning to work, has had a further depressing effect upon the steel industry, as with fuel supplies still withheld for an indefinite period, business on any scale of magnitude is obviously impossible. That steel makers are now realising the hopelessness of withstanding foreign competition at the existing range of prices is evidenced by the unanimous determination on the part of producers to reduce quotations, both the Scottish and English Associations having just announced substantial cuts in their respective lists of values. The first-named have now decided upon a new minimum basis of prices for the home trade, as follow:—Ship plates, ¾ in. and up, £15 per ton; angles, sections and joists, £14 10s. per ton; rounds and squares, 3 in. to 5½ in., £15 per ton; boiler plates, £20 per ton. In England angles and joists are reduced from £17 10s. to £14 10s.; tees to £15 10s.; boiler plates from £26 to £21; ship, bridge and tank plates from £19 to £15. Mills are idle owing to the coal strike, and the success of the present effort to recapture lost trade is largely contingent upon prompt resumption. The probable scarcity of home-produced pig-iron is a source of anxiety. In South Staffordshire increased offers of foreign-made "semis" are reported, and it is suspected that much of it is really of German origin. The market for both home and foreign material, however, is very small. Steel strip makers will be faced with the problem of foreign competition when work is resumed. Hitherto they have made much strip from imported steel, but now it is reported that the strip itself is being offered by foreign competitors at less than the Midland price.

Metals.

Copper.—The week's markets for this metal opened a shade easier, July deliveries selling at 5s. below the previous closing figures. Exchange movements in the States influenced some selling pressure, August being done at £71 12s. 6d., but under sales of July dates prices declined to £71 5s. for this position, with three months selling at £71 12s. 6d. Subsequently September was sold at £71 15s., and August dates at £71 5s., cash being £71, and three months, £71 2s. 6d. Electrolytic, £75 to £77; sheets, £116; India, £116; wire bars, prompt, £76. American prices spot, 12.50 c. = £74 5s.

Tin.—With Eastern advices showing a weaker tendency, Monday's opening market on this side developed a similar sentiment, early transactions registering a loss of 30s., with cash at £166. As regards the forward position, rather more activity was in evidence, July dates selling at £168, August £169 5s. to £169, end of August £170, September £168 to £170. Closing prices were:—Standard cash, £164 10s. to £164 15s.; three months, £167 5s. to £167 10s.

The London Metal Exchange tin statistics give the world's visible supply at the end of May as 19,829 tons, against 17,145 at the end of April. The increase is due to the larger shipments recorded, 5,304 tons in May, against 3,604 in April, making the total afloat 6,722, compared with 4,624 tons. The quantity landing and in transit also increased from 415 to 1,265 tons.

Spelter.—Although there was a fairly active demand for spelter, the week's markets opened with some weakening in values, both for near and forward delivery, with the sales for June at £26 5s. to £26 10s., July £26 10s. to £26 12s. 6d., August £27 to £26 17s. 6d., and September £27 5s. English was nominal at £33, and electro 99.9, £36 per ton.

Lead.—The market for soft foreign pig remains quiet and unchanged, sales on Monday totalling 200 tons, with June deliveries quoted £22 2s. 6d; English, £23.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

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In Soft, Mild, Medium, High Tensile, H H Tensile, Nickel and Alloy Steel.

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RAILS, TRAM RAILS, STEEL SLEEPERS, STEEL JOISTS to 24 in. deep. CHANNELS, ANGLES, BARS, SHEARED PLATES, FLITCH PLATES to 36 in wide, &c.

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COPPER.

	£	s.	d.
Standard cash	70	7	6
Three months	70	10	0
Electrolytic	75	0	0
Tough	71	0	0
Best selected	71	5	0
Sheets	116	0	0
India	116	0	0
Wire bars	77	10	0
Do. July	78	0	0
Do. Aug.	78	0	0
Ingot bars	77	0	0
H.C. wire rods	84	0	0
Off. aver. cash, May	73	5	10⅛
Do. 3 mths., May	72	11	1
Do. Settlement May	73	5	2⅜
Do. Electro, May	74	15	8⅞
Do. B.S., May	74	1	8
Aver. spot, copper, May	73	5	2⅜
Do. Electro, May	75	6	2½
Solid drawn tubes		15½d.	
Brazed tubes		15½d.	
Wire		11½d.	
Yellow metal rods		8½d.	
Do. 4x4 Squares		10½d.	
Do. 4x3 Sheets		10½d	

BRASS.

Solid drawn tubes	13½d.
Brazed tubes	16½d
Rods	12⅝d.
Sheets to 10 w.g.	12d.
Wire	11¾d.
Rolled metal	11½d.

TIN.

	£	s.	d.
Standard cash	164	10	0
Three Months	167	5	0
English	162	0	0
Bars	164	0	0
Chinese	159	10	0
Straits	165	5	0
Australian	165	10	0
Eastern	171	10	0
Banca	170	0	0
Off. aver., cash, May	177	10	8⅞
Do. 3 mths., May	178	19	10½
Do. Sttlment., May	177	9	0½
Aver. spot, May	177	8	4

SPELTER.

	£	s.	d.
Ordinary	26	15	0
Remelted	23	0	0
Hard	16	10	0
Electro 99.9	36	0	0
English	33	0	0
India	21	10	0
Prime Western	28	10	0
Zinc dust	50	0	0
Zinc ashes	6	0	0
Off. aver., May	27	6	7½
Aver., spot, May	26	18	5½

LEAD.

	£	s.	d.
Soft foreign ppt	21	15	0
English	23	0	0
Off. average, May	23	7	3¾
Average spot, May	23	7	8¼

ZINC SHEETS.

	£	s.	d.
Zinc sheets, spot	36	0	0
Do. V.M. ex. whf.	36	0	0
Do. ppt., f.o.b., N.Y.		—	
Dutch	36	0	0
Boiler plates	33	0	0
Battery plates	32	10	0

ANTIMONY.

	£	s.	d.
English regulus	37	0	0
Special brands	42	0	0
Chinese	24	10	0
Crude	18	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	10	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	£15 10 0
75%	£22 0 0
Ferro-vanadium—	
35/40%	22/- lb. va.
Ferro-molybdenum—	
70/80%	10/- lb. mo.
Ferro-titanium—	
23/25%, carbonless	1/6 lb.
Ferro-phosphorus, 20/23%	£29
Ferro-tungsten—	
80/85%, carbon free	1/9 lb.
Tungsten metal powder—	
98/99%	2/2 lb.
Ferro-chrome—	
4/6% car.	£37 0
6/8% car.	£36
8/10% car.	£35 10
Ferro-chrome—	
Max. 2% car.	£82
Max. 1% car.	£98
Max. 0.75% car.	£112
65/75%, carbonless	2/9 lb.
Nickel—99·8%, cubes or pellets	£185
Cobalt metal—97%	15/- lb.
Aluminium—98/99%	£150
Metallic Chromium—	
98/99%	6/- lb.
Ferro-manganese—	
76/80%, loose	£18
76/80%, packed	£19
76/80%, export	£15
Metallic manganese—	
98/99%, carbonless	2/10 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9
Scrap pieces	5d.	
Turnings and swarf	3d.	

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb
Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness	3d. lb.
Bevels of approved sizes and sections	6d. lb.
If in coils	3d. lb.
Packing	4s. cwt

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces	5d.
Turnings and swarf	3d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.
South Wales—£ s. d.			
Heavy Steel	3	5	0
Bundled steel & shearings	2	15	0
Mixed iron & steel 1 0 0	3	10	0
Heavy cast iron	3	15	0
Good machinery for foundries	5	10	0
Cleveland—			
Heavy steel	2	10	0
Steel turnings	2	5	0
Cast-iron borings	2	5	0
Heavy wrought iron piling	2	15	0
Bundling scrap	4	0	0
Cast-iron scrap	5	10	0
Lancashire—			
Cast iron scrap	6	10	0
Heavy wrought	3	0	0
Steel turnings	1	10	0
London—			
Copper (clean)	53	0	0
Brass (clean)	30	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	12	0	0
New aluminium cuttings	70	0	0
Braziery copper	43	0	0
Gun metal	45	0	0
Hollow pewter	135	0	0
Shaped black pewter	80	0	0

PIG-IRON.

(Premiums required for foundry).

N. E. Coast—	
Foundry No. 1	125/-
Foundry No. 3	120/-
Forge No. 4	117/6
Mottled	117/6
Hematite No. 1	162/6
Hematite M/Nos.	160/-
Midlands—	
Staffs. common	145/-
,, part-mine forge	160/-
,, ,, foundry	170/-
,, Cold blast	320/-
,, basic	140/-
Northants forge	140/-
,, foundry No. 3	147/6
,, basic	140/-
Derbyshire forge	150/-
,, foundry No. 3	160/-
,, basic	150/-
Scotland—	
Foundry No. 1	170/-
,, No. 3	165/-
Hematite M/Nos.	180/-
Sheffield (d/d district)—	
Derby forge	155/-
,, foundry No. 3	160/-
,, basic	155/-
Lincs. forge	160/-
,, foundry No. 3	170/-
,, basic	162/6
E.C. hematite	173/-
W.C. hematite	176/-

All d/d in the district.

Lancashire (d/d eq. Man.)—	
Derby forge	—
,, foundry No. 3	170/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	172/6
,, foundry No. 3	177/6
Summerlee foundry	193/-
Glengarnock foundry	195/6
Gartsherrie foundry	193/-
Monkland foundry	193/-

FINISHED IRON & STEEL.

	£	s.	d.
Iron—			
Bars (cro'n)	19	0	0
Angles	19	10	0
Tees to 3 united ins.	20	0	0
Nut and bolt	19	0	0
Hoops	23	0	0
Marked bars (Staffs.)	27	10	0
Gas strip	22	0	0
Bolts and nuts, ⅜ in. × 4 in.	38	0	0
Steel—			
Ship plates	15	0	0
Boiler plates	21	0	0
Chequer plates	20	0	0
Angles	14	10	0
Tees	15	10	0
Channels	15	0	0
Joists	14	10	0
Rounds, ⅜ in.–3-in.	14	0	0
Rounds, 3 in.–5½ in.		—	
Flats, 5 in.–8 in.		—	
Flats over 8 in.		—	
Rails, heavy	15	0	0
Fishplates	20	0	0
Hoops	16	10	0
Black sheets, 24 g.	19	10	0
Galv. cor. sheets, 24 g.	22	0	0
Galv. fencing wire, 8 g. plain	23	10	0
Rivets, ¾ in. dia	27	0	0
Billets, soft	11	10	0
Billets, hard	12	10	0
Sheet and tin bars	11	10	0

PHOSPHOR BRONZE.

ROLLED.	Per lb. s.	d.
½ in. to 1 in. wide	1	8¾
1 in. to 1½ in. wide	1	8¾
1½ in. to 2 in. wide	1	6¾

STRIPS.	s.	d
2 in. to 6 in. to 26 S.W.G.	1	6¼
6 in. to 12 in. to 26 S.W.G.	1	6¼

SHEETS.		
12 in. to 18 in. to 24 S.W.G.	1	6½
18 in. to 24 in. to 24 S.W.G.	1	7½
24 in. to 30 in. to 20 S.W.G.	1	8¼
30 in. to 36 in. to 16 S.W.G.	1	9¾
36 in. to 42 in. to 16 S.W.G.	1	9¾

EXTRAS.

FOR GAUGE: Any width up to 36 in. wide, ¼d. per lb. per thinner gauge.

DRAWN RODS.	s.	d.
¼ in. to ½ in. dia. in random lengths; ⅝ in. to 1¼ in. dia. in random lengths	1	6
Over 1¼ in. to 1½ in.	1	6
Tubes—basis price	1	8¾

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/– to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks	1/1 to 1/7
Ingots rolled to spoon size	1/4 to 1/10
Wire round—	
3/0 to 10. G.	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	25.50
No. 2 foundry Valley	22.50
No. 2 foundry, Birm.	20.00
Basic	22.96
Bessemer	24.96
Malleable	24.96
Grey forge	23.46
Ferro-manganese 80 % delievred	75.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	37.00
O.-h. billets	37.00
O.-h. sheet bars	39.00
Wire rods	48.00
	Cents.
Iron bars, Phila.	2.25
Steel bars	2.10
Tank plates	2.00
Beams, etc.	2.20
Skelp, grooved steel	2.10
Skelp, sheared steel	2.10
Steel hoops	2.75
Sheets, black, No. 28	3.85
Sheets, galv., No. 28	5.00
Sheets, blue an'l'd, 9&10	2.90
Wire nails	3.00
Plain wire	2.75
Barbed wire, galv.	3.85
Tinplate, 100-lb. box	$6.25

COKE.

Welsh foundry	67/6
,, furnace	55/-
Durham & North. foundry	70/-
,, furnace	42/6
Other Districts, foundry	77/9
,, furnace	45/-

SWEDISH IRON.

Bars, hammered basis sizes Basis price £31 to £32

Rolled Ordinary— Assortment .. £ 22 s. 10 d. 0 to 23 10 0

Nail Rods— Square, round and flats .. £ 22 s. 10 d. 0 to 23 10 0

Keg Steel .. £38 to £40

Faggot Steel .. £30 to £32

Blooms— Single welded .. £16 to £18

Billets— Single and double welded .. £18 to £20

Pig-Iron— Grey, white or mottled £10/10 to £11 10

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

	Up to and incl. 2 in.	Over 2 in.
Gas ..	−15%	−20%
Water ..	− 5%	−11½%
Steam ..	+ 6¼%	− 1¼%

TINPLATES.

I.C. Cokes,	20×14, box	26/-
„	28×20, „	51/-
„	20×10, „	35/-
„	18¾×14, „	29/-
I.X.	„	64/-
I.X.X.	„	84/-
F.C.B.Y.	21×13⅝ „	48/6
C.V.B.G.	16½×15, „	49/-
I.C.W.	20×14, „	20/-
„	28×20, „	39/6
„	20×10, „	23/-
„	18¾×14, „	16.9
Terneplates,	28×20, „	52/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
June 15	73	0	0	dec.	7/6
„ 16	72	12	6	„	7/6
„ 17	71	17	6	„	15/-
„ 20	71	0	0	„	17/6
„ 21	70	7	6	„	12/6

Electrolytic Copper

June 15	77	0	0	No change	
„ 16	77	0	0	„	
„ 17	77	0	0	„	
„ 20	76	0	0	dec.	20/-
„ 21	75	0	0	„	

Standard Tin (cash).

June 15	168	15	0	inc.	25/-
„ 16	170	5	0	„	30/-
„ 17	167	10	0	dec.	55/-
„ 20	166	10	0	„	20/-
„ 21	164	10	0	„	40/-

Tin (English Ingots)

June 15	167	10	0	No change	
„ 16	170	0	0	inc.	50/-
„ 17	167	0	0	dec.	60/-
„ 20	166	0	0	„	20/-
„ 21	162	0	0	„	80/-

Zinc Sheets (spot).

June 15	36	0	0	No change
„ 16	36	0	0	No change
„ 17	36	0	0	No change
„ 20	36	0	0	No change
„ 21	36	0	0	No change

Spelter (ordinary).

June 15	26	15	0	dec.	5/-
„ 16	26	15	0	No change	
„ 17	26	15	0	„	
„ 20	26	5	0	dec.	10/-
„ 21	26	15	0	inc.	10/-

Lead (English).

June 15	23	5	0	No change	
„ 16	23	5	0	„	
„ 17	23	5	0	„	
„ 20	23	5	0	„	
„ 21	23	0	0	dec.	5/-

SHROPSHIRE IRON Co., Ltd.

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Telephone:— 11 Wellington, Salop. 3959 Central.

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Galvanised Telegraph, Telephone, Cable and Trolley Wire

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R.H. ♔ IRON. Delivered F.O.B. Liverpool. BARS, ANGLES, TEES and PLATES.

HOOPS delivered F.O.B. Liverpool.

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MILD STEEL (up to 2in. wide) Marked "HEATH'S SOFT STEEL."

Prices on Application.

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COPPER — ANTIMONY—MANGANESE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

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FOUNDRY FOREMAN disengaged. Prefer entire charge of shop. 20 years' experience in jobbing, plate and machine. Good references. — Box 774, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PATTERN-MAKER, aged 28, desires situation; experience in all branches; last place well-known City firm.—Write, E. Harding, 85, Chatterton Road, Bromley, Kent.

IRON FOUNDRY FOREMAN COREMAKER desires change; make your own core oil, 80 parts sea-sand 1 part oil.—Box 770, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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REPRESENTATION.—Wanted, in London and District, with wide connection, to represent Non-Ferrous Foundry for the supply of Engineer and Motor Trade Castings (on Admiralty and War Office Lists), output fifty tons weekly. Only established and influential firms considered.—Reply Box 762, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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THE owners of British Patent, No. 18386/14, entitled "Cementation Process for Armour Plates Employing Mixed Cementation Agents," desire to dispose of the Patent, or to enter into working arrangements with a firm likely to be interested in same. A copy of the specification and particulars may be obtained from Hertford Record Company, Limited, of Lindsey House, 59, Lincoln's Inn Fields, London, W.C.2.

ADVICE and Handbook Free. — KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

MACHINERY.

TURN TO THE B.W.S. ANNOUNCEMENT, PAGE 8.

CRANES.—Two Hand-Power Foundry Jib Cranes, about 17 ft. radius, and about 12 ft. under jib; to lift about four tons each. Can be seen at work.—Box 772, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOR SALE.

CROSS COMPOUND HORIZONTAL CORLISS ENGINE, "Wheelocks" system, 15 in. and 24 in. cyls., 36 in. stroke, by D. Adamson & Company.

TWO CROSS COMPOUND HORIZONTAL DROP VALVE ENGINES, 12½ in. and 20 in. cyls., 26 in. stroke, by Robey & Company, Limited.

CROSS COMPOUND HORIZONTAL ENGINE, 11 in. and 19 in. cyls., 26 in. stroke, by Marshall, Sons & Company, Limited.

CROSS COMPOUND HORIZONTAL ENGINE, 11 in. and 17½ in. cyls., 20 in. stroke, by J. Fowler & Company, Limited.

VERTICAL COMPOUND OPEN TYPE ENGINE, 15 in. and 22 in. cyls., 18 in. stroke, by Browett, Lindley & Company.

VERTICAL COMPOUND OPEN TYPE ENGINE, 15 in. and 21 in. cyls., 10 in. stroke, by Robey & Company, Limited.

VERTICAL COMPOUND OPEN TYPE ENGINE, 12 in. and 19 in. cyls., 12 in. stroke, by Tangyes, Limited.

VERTICAL COMPOUND TOTALLY ENCLOSED ENGINE, 10 in. and 14 in. cyls., 8 in. stroke, by Thwaites Bros., Limited.

VERTICAL CROSS COMPOUND ENGINE, 7½ in. and 12 in. diam., 8 in. stroke, by Thornycroft & Company.

PAIR OF HORIZONTAL ENGINES, cyls. 11 in. diam., 14 in. stroke, by Robey & Company.

CATALOGUE of STOCK MACHINERY, 5-6,000 Lots.

Free on Application. Inspection Invited.

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HALL'S Invincible Sand Mixer, capacity 1 ton per hour, 18 in. dia., equal to new, suitable for mixing and preparing all kinds of foundry sands at the lowest cost per ton.—Apply, C .E. V. HALL, 26, Paradise Square, Sheffield.

You save money by buying from us!

Lancashire Boiler, 30 ft. x 8 ft., for 120 lbs. w.p.
Loco. Type Boiler, by Robey, 105 lbs. w.p.
5-ton Overhead Foundry Crane, 30 ft. span.,
35-h.p. Modern Crossley Gas Engine, "U" Type.
20, 30, 40 and 50-h.p. Electric Motors, 460 Vo. D.C.
Blowers, Fans, Engines, etc. Send your enquiries, HARRY H. GARDAM & COMPANY, LIMITED, Staines. 'Phone 98.

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SPECIAL OFFER. Subject to being Unsold. Best New Perfect Sheffield Files. 14-in. Hand Bastard, parallel, one safe edge; makers, John Kenyon & Company, Sheffield. 12-in. Hand Second Cut, parallel, one safe edge; makers, Camm, Bagshaw & Company, Sheffield. All at 18s. per dozen. Carriage paid on 12 dozen lots.—SMITH BROS., Aylestone Park, Leicester.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—JAMES G. CROWTHER, Paradise Street Brass Foundry, Sheffield.

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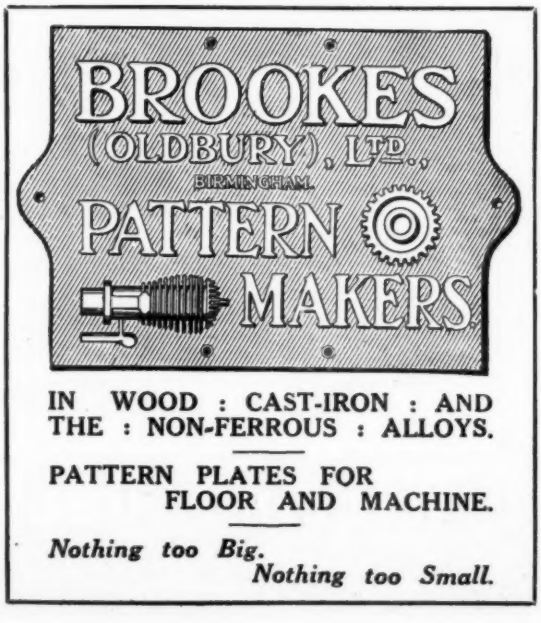

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